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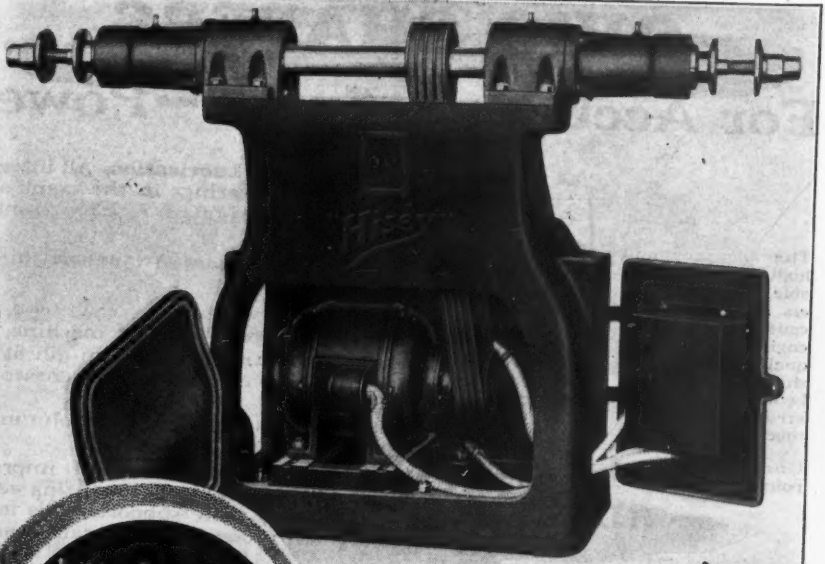

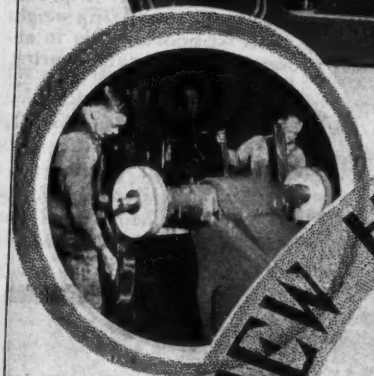

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(5) Gooseneck construction gives the operator plenty of foot room—makes it easy for him to handle bulky and odd-shaped pieces.

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(c) Single screw adjustment of ram gib at front and rear of column to compensate for wear.
(d) Exceptionally long ram and long column bearing.

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The Ohio Machine Tool Co.
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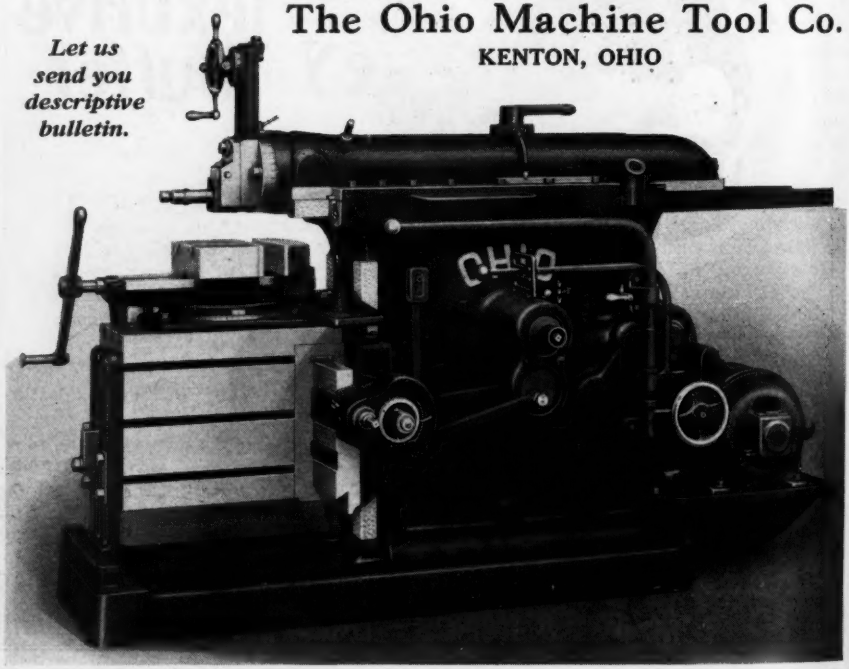

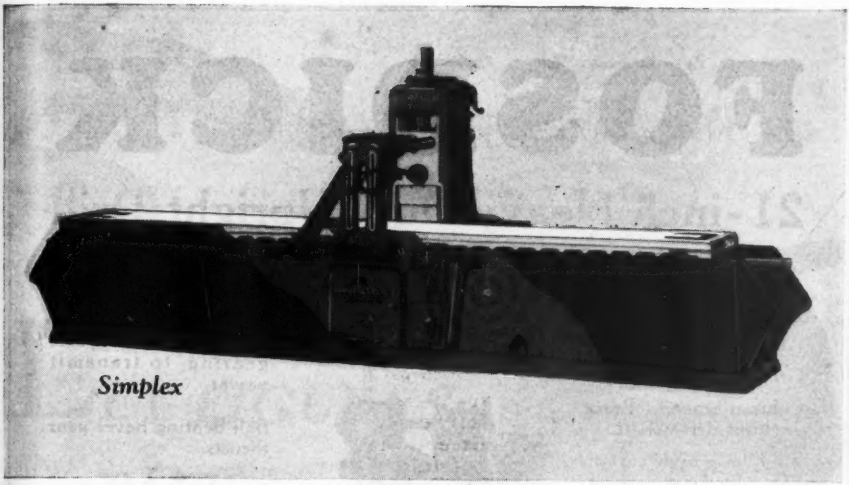

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HAVE you ever wanted a milling machine that was different from the standard types and sizes available — something that would match up identically with your requirements and yet be standard in construction?

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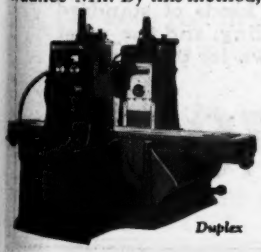
They have carefully planned and executed a complete series of standard units that comprise what is known in the aggregate as the Mil-waukee-Mil. By this method,



Duplex

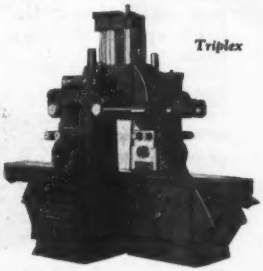
a variety of general purpose, or even special single purpose machines, can be produced in such a way as to realize the advantage of standard jigs, fixtures, drawings, and patterns throughout the greater part of their construction.

The name "Mil-waukee-Mil" does not apply to a single milling machine. Rather, the term means any one of a thousand different combinations of standard units—units that you yourself may select.

The Mil-waukee-Mil Plan was conceived with but one thought in mind—to give to the user a production milling machine of standard construction throughout, yet perfectly adapted to his special needs.

The outstanding advantage of the Mil-waukee-Mil Plan is not only in the machine itself, but also in the production service that is back of it.

Kearney & Trecker have inaugurated something that is new in machine tool design. In addition to this they have placed at your disposal the



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engineering counsel to assist you in the selection, design, and application of the proper units best suited to your needs. The same engineers who conceived and developed the Mil-waukee-Mil Plan are at your service to solve your milling problems.

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This machine has been especially designed to meet the demand for a high-grade, rigid, accurate, powerful drill for all kinds of standard drilling and tapping jobs. All-geared drive for drilling, and the most powerful friction reverse tapping mechanism known for tapping.

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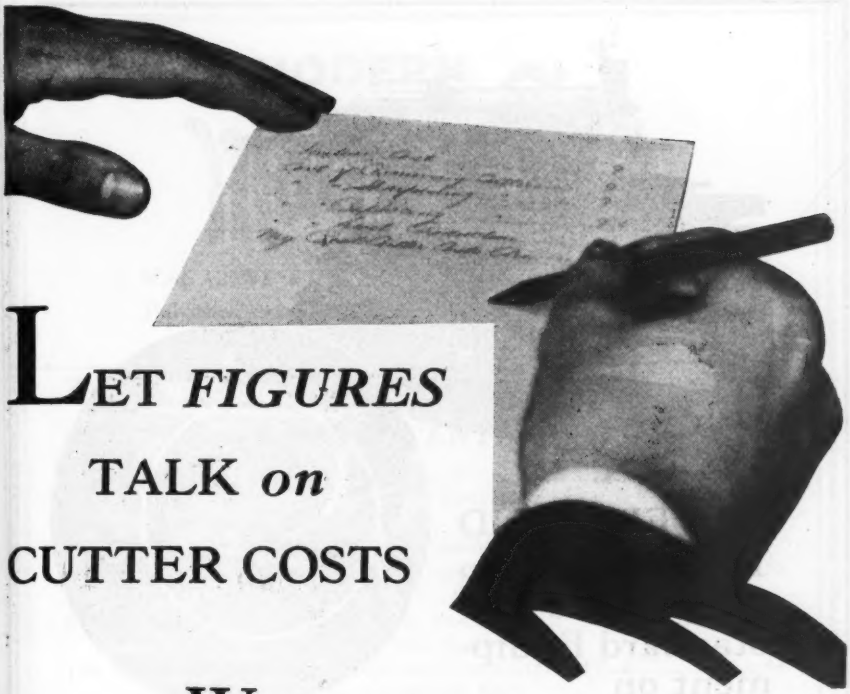

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When you check up final results, you will find that the first cost isn't the real cost by any means. Cold figures will prove to you that good cutters—Brown & Sharpe Cutters—can save you time and money. Keep a copy of Catalog No. 30 on hand for cutter reference. Address Dept. MM.

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MODERN
Machine Shop

A MAGAZINE FOR MACHINE SHOP EXECUTIVES

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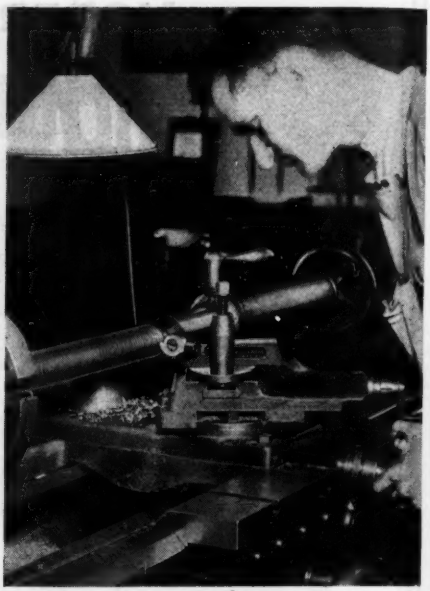

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APRIL, 1929
CINCINNATI, OHIO VOL. 1, NO. 11

Operations on "Argo" Airplane Parts

By HOWARD CAMPBELL

THE "Argo" airplane, built by the Alliance Aircraft Corporation, Alliance, Ohio, is a two-passenger biplane intended for easy handling at high speeds, and weighing approximately 1,000 pounds. The engine is the "Hess-Warrior"—a seven-cylinder power plant of the radial type, developing 125 h. p. at 1,800 r. p. m. The materials used in the construction of this engine are those recommended by U. S. Army and Navy standards, and some of the manufacturing operations are particularly interesting.

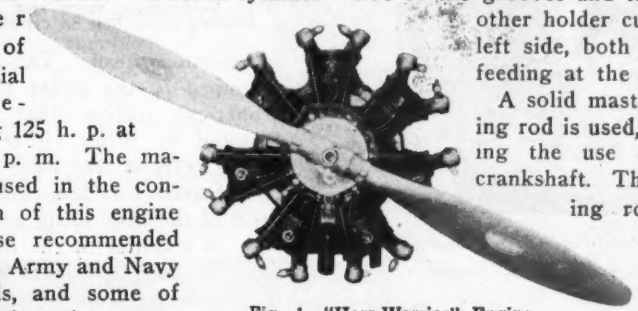
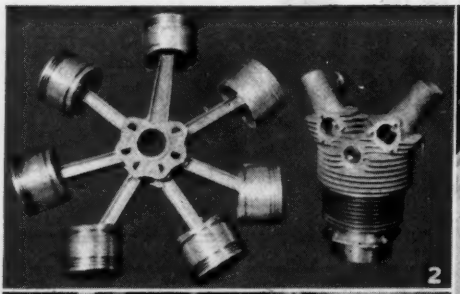
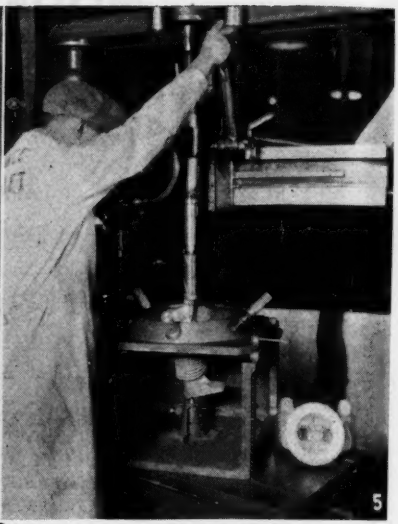


Fig. 1—"Hess-Warrior" Engine.

The cylinders, one of which is shown at the right in Fig. 2, are of forged steel with aluminum heads, screwed and shrunk on. The "fins" on the outer surface of the cylinder are cut by swinging the piece in a lathe, as shown in Fig. 3, and using two sets of tools to cut the grooves between the fins. The cylinder is first bored and reamed, and is then slipped onto an expanding mandrel for locating between centers. Two sets of eight tools each are used for this operation, one at the front and the other at the rear, as shown. The tools in one holder cut in at the right side of the grooves and those in the other holder cut in at the left side, both tool-blocks feeding at the same time.

A solid master connecting rod is used, necessitating the use of a split crankshaft. The articulating rods are I-beam sections, and all rods are machined all over. A connecting rod and piston assembly is shown at the left in Fig. 2. The operation of machining the chamber in the master rod for the inner ends of the articulating rods is shown in process in Fig. 4. The rod is bolted to a fixture that is located the correct distance off center on the milling machine table, and the table is revolved by hand feed. A set of three interlocking cutters is





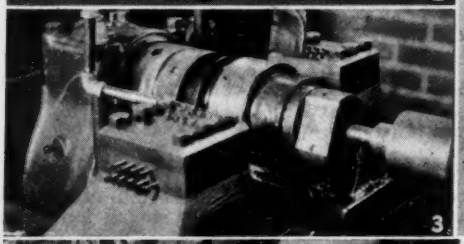


Fig 2—(Left) Connecting rod and piston assembly. (Right) Drop forged steel cylinder. Fig. 3—Machining the "fins" on the cylinder. Fig. 4—Machining chamber in master rod for articulating rods. Fig. 5—Reaming valve seat and valve bushing guide hole in cylinder head.

used, machining a smooth surface on both sides and bottom of the chamber, and holding the opening to a limit of .003 on the width and .002 inch on the depth.

The knuckle pin holes in the master rod are reamed within a limit of .0005 inch, and must be parallel with the axis of the rod. These holes are tested after reaming by slipping arbors into the holes and then gauging with the micrometer.

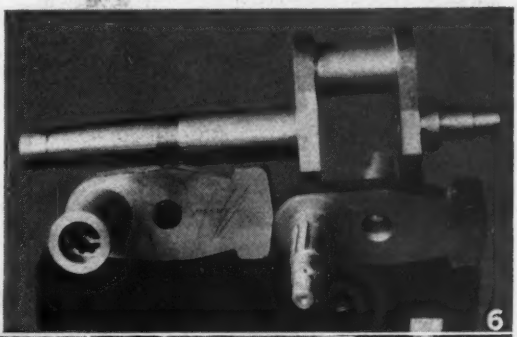
The mechanic shown in Fig. 5 is drilling and counterboring the valve seat and valve bushing guide hole in a cylinder head. The head is clamped to the under side of a spherical section that can be rotated to bring either of the valve seats in line with the drill, the correct location of the outer end of the hole being assured by the use of a center in the bottom of the jig. As each valve seat is aligned with the machine-spindle, this center is raised and located in a center-hole in the rocker arm box. After the head has been clamped, the center is lowered again so that the tools can clear the hole.

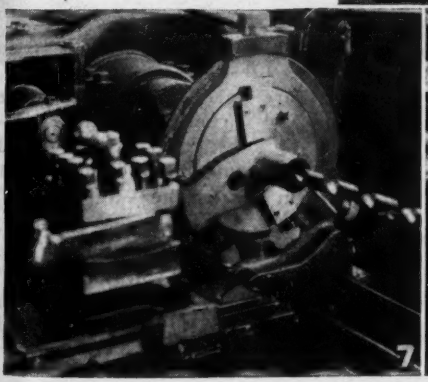
The cylinder heads are bored and tapped in a turret lathe, then they are heated in an electric furnace to approximately 650 degrees F., and are screwed onto the cylinder while hot. As a shrink fit of .013 inch is allowed for in the boring and threading, it is

obvious that the head, once on, is on to stay. Although the motor heats to a temperature of from 150 to 180 degrees in operation, this is not enough to expand the head perceptibly.

The crankshaft is made in two parts, the connecting rod journal, which is a part of the front half, being bored and splined to receive a corresponding projection on the rear half. The two halves, together with an assembled shaft, are shown in Fig. 6. In order to make sure that the hole in the journal is exactly 2¼ inches off center and in perfect alignment with the axis of the shaft, the boring operation is done in the turret lathe shown in Figs. 7 and 8. The shaft is held in a fixture which consists of two parts—a special steadyrest in which the disc that holds the shaft revolves, and the part in which the shaft is held, which is attached to the spindle of the machine at one end, and revolves in the steadyrest at the other. The end of the shaft on which the work is to be done is held in the disc in which it revolves by means of screws in two blocks that are attached to the plate. The screws provide means for adjustment as well as for clamping. The off-center dimension, which must be within .001 inch, is provided for by the pockets in which the shaft is clamped, shown in Fig. 8.

The splines are cut on the rear section of the crankshaft with a milling machine, but the internal splines, in the front half, are cut with a single tool in the vertical shaper shown in Fig. 9. Perfect accuracy is obtained on the spacing of the ten splines by the use of an indexing fixture. This machine is also used for such jobs as that of cutting taper keyways and other jobs that might be difficult or





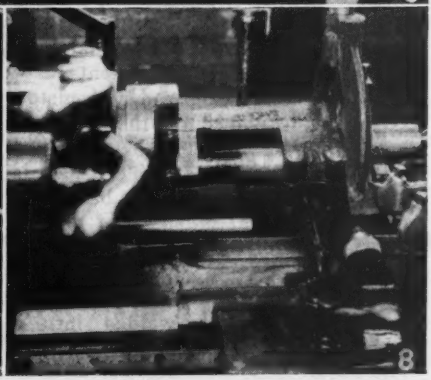


Fig. 6—Crankshaft, assembled and disassembled. Fig. 7—Drilling front half of crankshaft for splining. Fig. 8—Rear view of steadyrest, showing method of holding piece.

require the use of expensive fixtures if handled on other machines. In Fig. 10 the machine is shown set up for cutting ⅛ inch keyways in taper holes in magneto couplings. The holes are .078 inch deep by .127 inch wide by 1⅛ inch long and taper 5 degrees 43 minutes. A keyway is finished in each piece complete, in 2½ minutes.

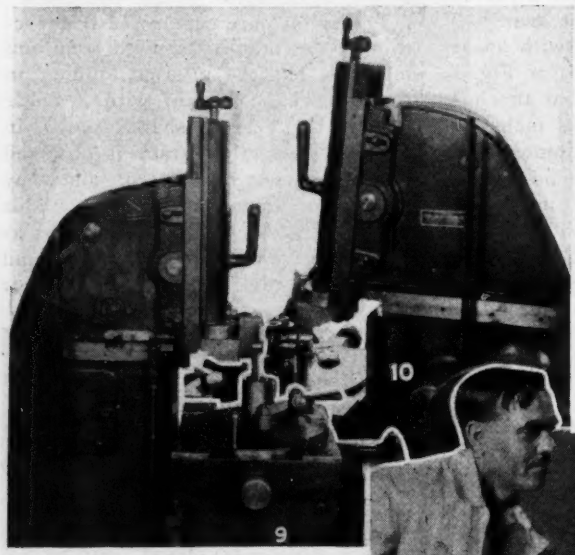


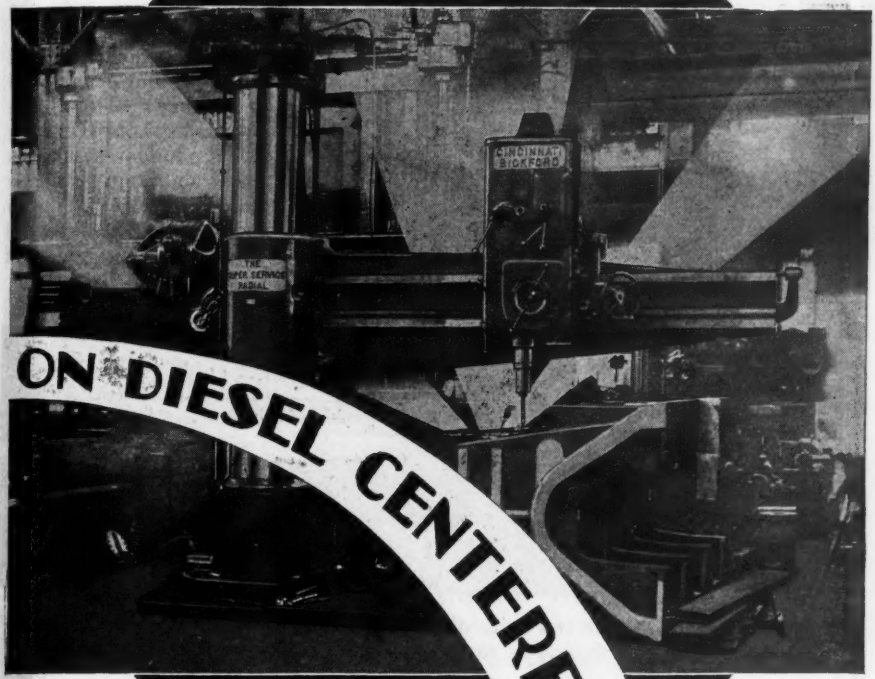
Fig. 9—Using vertical shaper to spline hole in crankshaft. Fig. 10—Cutting keyway in taper hole with vertical shaper. Fig. 11—Balancing crankshaft on Sundstrand balancing way.

When finished, a weight equal to the weight that is represented by the connecting rod and piston assemblies is placed on the crankpin and counterweights are then screwed to the shaft to balance. The shaft is balanced on a Sundstrand balancing way, Fig. 11, and must be in perfect balance before it is released for assembly.

The fuselage material is chrome molybdenum tubing, welded into a rigid structure in which the Warren truss type of bracing is employed. The tubing varies in diameter from 1⅛ inches in diameter to ⅝ inch, according to the position in which it is used, with walls varying from .058 inch to .035 inch. In building the fuselage, the pieces of tubing are first clamped in jigs which hold them in the correct relative positions, where they are joined together with the welding torch. The mechanic shown in Fig. 12 is finishing the welding operation, which is done after the section has been removed from the jig so that every part of it is accessible.

An upper wing section is shown in process of construction in Fig. 13. The spars are of spruce, unrouted, and the ribs are made up of Haskelite plywood and spruce. Stewart Hartshorn tie rods, attached to zinc-plated fittings of chrome molybdenum sheet stock, form the bracing, and the "N" struts, which tie the wings together, are also of chrome molybdenum tubing.

The covering used on the "Argo" plane is Flightex fabric doped with seven coats of nitrate dope and sprayed with two coats of lacquer.



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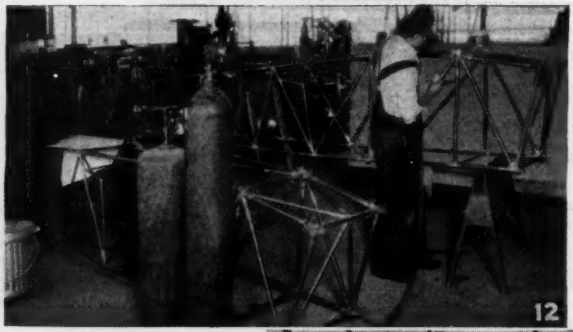

in one large tank in the center section of the wing, and the fuel lines are of half-inch annealed copper tubing, cushioned in rubber. The plane weighs approximately 1,000 pounds without a load, and approximately 1,650 pounds when loaded. While intended for a cruising speed of

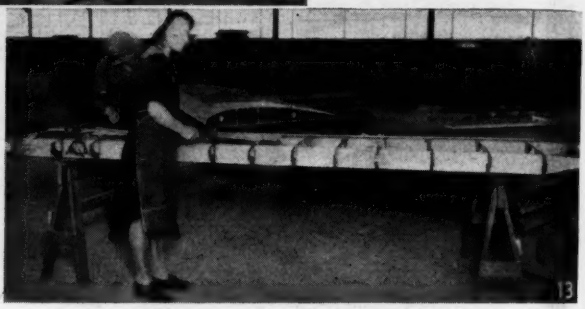

Fig. 12—Welding the joints in the fuselage. A jig is used to make sure that each piece is in its correct position before welding. Fig. 13—The wings are built of spruce and Haskelite plywood, with a covering of Flightex fabric.

A propeller of steel with adjustable pitch, designed especially for use with this airplane, is used. Gasoline is carried 100 miles per hour, 130 miles per hour can be attained when necessary.

Selecting Equipment

Often a machine that will be expected to give good service for many years will be selected in a few hours. An error in selection is made but once, but the effect of the error is evident every time the machine is used.

In order to be able to select a machine intelligently, the purchaser should be familiar with all the different types of machines that are available for the class of work for which the machine is to be used. As it is seldom that a complete variety of machines is found in one shop, the next best way to obtain a working knowledge of the various types and kinds of machines is through both the editorial and advertising pages of this magazine. Here, each month, manufacturing operations on various kinds of metal products are reviewed, and the best available data on modern shop practice is presented for the edification of the reader. After a knowledge of the existing types of machines has been obtained, further and more specific information can be obtained from the catalogs that are issued by the manufacturers of the equipment. Or information and literature pertaining to any machine will be supplied by MODERN MACHINE SHOP upon request and without charge.

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For Machine Tools

THIS COMPANY manufactures two distinct types of plate clutches designed to improve and simplify the drive control of machine tools.

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TWIN DISC CLUTCH COMPANY
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Grinding Tungsten Carbide Tools

By K. B. SPAULDING
Sales Manager, The Wesson Sales Co., Detroit

WHILE it is a bit early to attempt to tell what effect the new tungsten carbide alloy tools will have on production in this country, developments thus far indicate the possibility of many changes in the design of machine tools in order to provide for greater speed and rigidity. The first of these alloys to be used in general machining practice was "Widia," a product of the Fried Krupp Works, at Essen, Germany, where it was introduced about three years ago. The success of the original applications led to its wide acceptance in Europe, and at this time there are more than 200,000 Widia tools in use abroad.

Widia is extremely hard, rating next to the diamond in the hardness scale. It will cut glass, hard porcelain, hardened steel, manganese steel, and many other materials heretofore considered outside the range of machineability. More important, however, is its ability to retain a keen cutting edge when used in machining highly abrasive materials such as cast steel or iron with sand inclusions or heavy scale, aluminum, bakelite, mica, etc. In this class of work the Widia tool frequently shows a life as high as one hundred times that of tools that were formerly used.

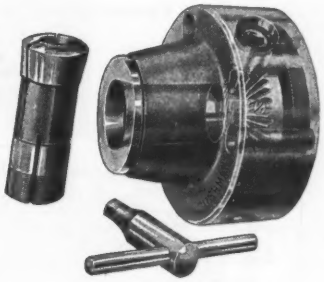
The manufacturers of the tools do not recommend that the cuts should be heavier than those taken with high speed steel tools, but rather that the speeds be increased several hundred per cent. For example, a number of cast iron parts are being machined in production at a speed cutting of between 550 and 650 feet per minute. Castings of 12% manganese steel, which formerly could only be machined with the grinding wheel, are now being turned in the lathe at a speed of 37 feet per minute with a depth of cut of .200 inch and a feed of .012 inch.

Widia is also being applied to operations that have ordinarily been handled with diamond boring tools, and are producing an entirely satisfactory finish. One distinct advantage of the tungsten carbide tool lies in the fact that it can be reground and relapped a number of times before it is worn out. The cost of such tools is, of course, very much less than that of diamond tools for the same purpose.

One of the plants that have recently started using Widia tools has recently reported that it has been possible to dispense with the use of a night shift because of the greater production obtained in the day-time with the new tools. In another plant, where the product consists of machined brass castings, production has been more than doubled and the purchase of additional equipment, which was under consideration, has been rendered unnecessary.

A well-known Wisconsin manufacturer recently started using Widia tools on the production of two parts, one of cast iron and the other of steel. The cast iron part, which is 7⅜ inches in diameter and 30 inches long, is being machined with a feed of .038 inch, a depth of cut of $\frac{3}{16}$ inch, and a surface speed of 560 feet per minute. The second piece, which is of 35-40 carbon steel, 5 inches diameter by 13 feet long, is being machined with a feed

If you machine *bar stock* you will want... *this New* CUSHMAN Nose Type Collet Chuck



The new No. 15 Cushman Nose Type Collet Chuck is designed to take collets of larger than usual size, and with it any bar that will pass through the lathe spindle can be held if it is not over 1¾-inches in size.

The body of the chuck is a solid piece of steel, heat-treated and ground perfectly true on both outer and inner surfaces.

Two ground bearings in the collet provide for accuracy in holding the work.

Discs and pinions are of a fine grade of alloy steel, carefully heat-treated.

The special type collets can be obtained in sizes from ½-inch to 1¾-inch, inclusive, from us or from any distributor.

Ask for details and prices!

THE CUSHMAN CHUCK CO.

805 WINDSOR STREET HARTFORD, CONN.

of .041 inch, a depth of cut of .100 inch, and a speed of 180 surface feet per minute.

The foregoing examples are quoted to indicate the wide variety of machining operations to which tungsten carbide tools can be adapted. The new alloy can not, however, be considered as a cure-all, and each application should be carefully studied to make sure that the proper feeds, speeds and cuts are used, that the tool is of the correct shape, and that it has been ground with the correct clearance and rake angles.

Widia comes in the form of small tips or plates which are mounted on high carbon steel shanks by brazing with copper. These tips are furnished in a variety of shapes and sizes that have been designed to meet the majority of tool requirements with a minimum of grinding. The extreme hardness of the alloy makes a special grinding wheel necessary. For most work it has been found advisable to use a roughing wheel, followed by a fine finishing wheel to obtain the desired keen edge. The tools should be ground "wet," and a plentiful supply of coolant should be used.

Care must be taken in grinding the tools, as over-heating is likely to cause burning and checking of the metal. The time required for dressing these tools, however, is only a very little longer than the time required for dressing other tools if the proper wheels are used. For best results, the cutting edge of Widia should be sharp and smooth. A little additional care used in giving the cutting edge a smooth finish will result not only in a much finer finish on the work but also in a considerable increase in the life of the cutting edge, thus permitting longer use of the tool between grindings. Where an exceptionally smooth finish is desired, it is

(*Continued on page* 30)

STANDARD LIP ANGLES

Recommended for best results in machining various materials.

LIP	USE	α CLEARANCE	β TOOL ANGLE	ø TOP RAKE	SIDE RAKE OR BACK SLOPE
No. 1	General Use (Supplied unless otherwise specified)	7°	72°	11°	4°
No. 2	Medium Steel, Etc.	7°	67°	16°	4°
No. 3	Soft Steels, Aluminum Alloys, Stainless Steels, Soft Steel Castings, Etc.	8°	62°	20°	4°
No. 4	Chilled Cast Iron, Silicon Cast Iron, Etc.	3°	83°	4°	4°
No. 5	Planer and Shaper Work (All Materials)	4°	77°	9°	13°

LEADERSHIP

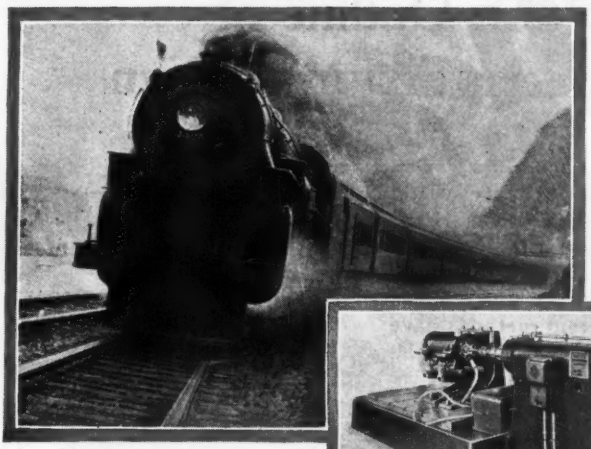


Photo courtesy N. Y. C. R. R.

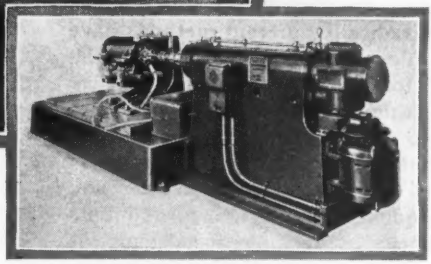


Illustration shows Hutto "MJ" for grinding locomotive cylinders

HUTTO CYLINDER GRINDERS UNIVERSALLY RANK FIRST

IT does not take long for good news to travel. In addition to being used by 95% of the motor car manufacturers, and by over 30,000 automotive service shops, the demand for Hutto Grinders has developed rapidly in other fields.

Today Hutto Cylinder Grinders are being used profitably in thirty-four (34) industries, and in every instance are recognized leaders.

There are hundreds of operations that can be Hutto Ground quickly, accurately, economically and satisfactorily. There are Hutto Machines for small and large production jobs, and they take work from piston pin holes $\frac{3}{4}''$ in diameter to locomotive cylinders.

The cooperation of our engineering department may be had on request. Let us help solve your internal grinding problems.

HUTTO ENGINEERING COMPANY, INC.

542 Lycaste Ave. **Detroit, Mich.**

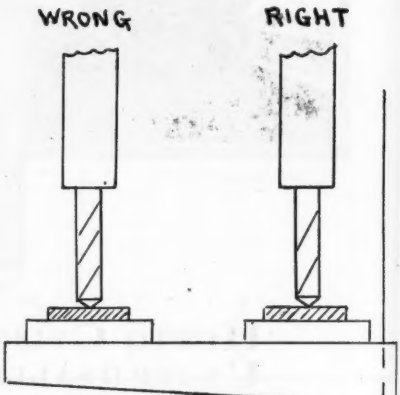
An Outline of Modern Fixture Design

By H. C. KLINE

WITHIN the past twenty years, two important changes have taken place in the art of tool designing. To meet the present-day demand for speed, accuracy, and reduced costs, radically different methods have been developed and because of the need for specialists, a new type of tool designer has come forward.

Two decades ago most fixtures were designed by mechanics who had served their time as machinists and consequently knew the ins and outs of shop practice. The usual aim was to produce a jig in which interchangeable parts could be machined, and very little effort was made to coordinate the tool with a specific machine. Gradually the modern method of designing the fixture to suit a certain machine has been evolved, but in the process the old-time designer has been largely supplanted by a new type. These new men are primarily draftsmen, and although they are not without shop experience, it has generally been limited to a brief machine shop course, supplemented by reading and casual contact with the factory. Another group consists of toolmakers or shop executives whose duties have lead them into the field of tool design. Since there are large numbers of both groups engaged in designing tools today, a brief review of some modern principles and a few suggestions regarding the more common shop mistakes may be timely and profitable to all readers.

Choosing the Best Type of Fixture



Locating the work too far from the machine column may spring the table.

In planning a new tool the first step is to find out whether a plain or production fixture will be most economical. This is determined by the machines available for the job and the number of pieces to be machined. With this information, it is not difficult to select the type of fixture needed by making a rough estimate of the cost of the operation. For example, the writer recently was required to tool up for drilling 1,000 hubs. A study of the estimate will

IMPOSSIBLE YESTERDAY ...

PRACTICAL TO-DAY

ANOTHER
ACHIEVEMENT OF

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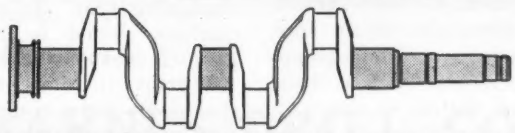
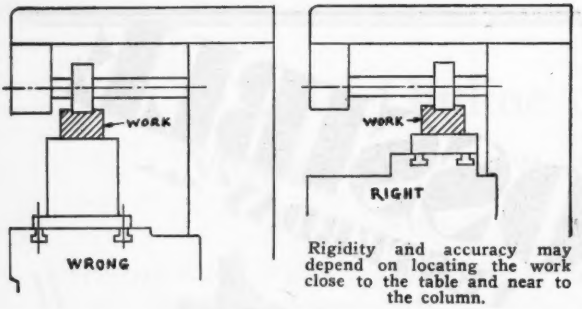
BUILDERS OF
"MASTER TOOLS OF INDUSTRY"



AUTOMATIC CRANKSHAFT LATHE SIMULTANEOUSLY TURNS THE ENDS AND MAIN BEARINGS INDICATED

Madison and Edwards Roads Cincinnati, Ohio



Rigidity and accuracy may depend on locating the work close to the table and near to the column.

show why a single fixture was decided upon.

Plain jig on single spindle machine.

Tool cost	$75.00
Labor (33 hours at 60c	19.80
Burden and Overhead at $1.20 per hr.	39.60
	$134.40 or $.134 each

Production jig on multiple drill.

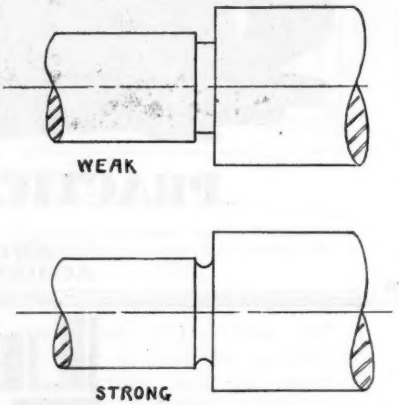
Tool cost	$150.00
Labor (16 hours at 60c)	9.60
Burden and Overhead at $1.30 per hr.	20.80
	$180.40 or $.18 each

If 10,000 parts had been required, production tooling would give a cost per hole of $.04, and even this figure would be reduced if more pieces were to be machined.

Points on Plain and Production Tools

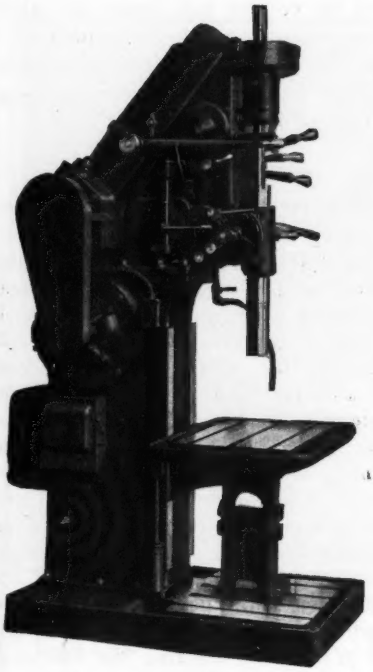
In designing a plain fixture, the basic idea is to develop an inexpensive tool which will do the work satisfactorily, even if operating time and labor have to be sacrificed. When only a small number of pieces are to be made, it is often possible to convert obsolete fixtures or to combine two or more operations, such as drilling, reaming, and milling in one tool. A scheme frequently employed in small shops making pieces of the same shape but of different sizes is to make adjustable parts, using adapters.

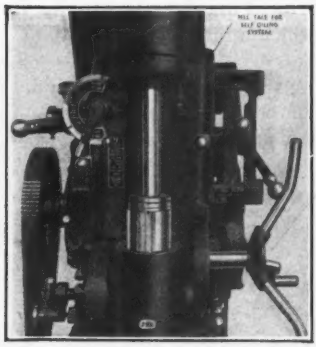
Should the quantity be great enough to warrant a production fixture, the main purpose is to combine the ideal machine with a jig that will produce the maximum number of pieces per hour. The controlling factor is not tool cost, but the speed at which the piece can be turned out. Multiple fixtures, indexing tables, and combination tools are permissible, and quick-clamp devices such as air-chucks or projections on the machine which clamp the work automatically are imperative. The tool should be constructed so that the period spent in loading, inspection or any other work on the part of the operator does not exceed the actual machining time. In other words the machine should be removing metal 100 per cent of the time.



Round corners are stronger than square ones, and sharp corners tend to crack in hardening.

Whether the designer is of the type that works out a complete mental picture or one who starts drawing with only a rough idea in mind, he must consider the requirements of the operation and the manner of locating the





Front view, showing convenient grouping of controls for the eight quick change speeds and an equal number of feeds, all clearly marked.

A Leader—
No. 242 Self-Oiling All-Geared Drilling Machine

For drilling, tapping, boring, reaming and kindred operations including cylinder-honing. Self-Oiling All-Geared Machines are the last word in equipment for the modern machine shop.

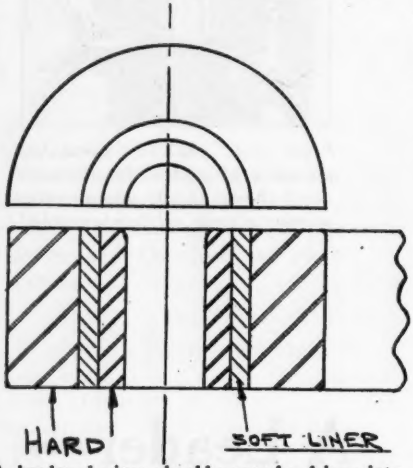
No. 242 drives a 2" drill to capacity in steel. It leads the Self-Oiling All-Geared Line and has all of the special features in design and construction which make these machines so profitable. These are fully described in Catalog U — send for it.

BARNES DRILL CO.

801-851 CHESTNUT STREET ROCKFORD, ILLINOIS

work. This data is usually furnished by the engineering department. At this point it is good practice to check into the possibility of using standard parts, such as bushings, clamps or other commercial products.

One system which has many advantages consists in tracing the part



A hardened piece should never be driven into another hardened piece. Use a liner of soft material.

drawing on the tool sheet in red, and then proceeding to build around it. With this as a base, the location points can be settled upon and drawn and the body of the jig roughed out. Location points should (a) be accessible for cleaning, (b) be adjustable for wear, (c) check previous operation, (d) prevent incorrect insertion of the work, and (e) make it easy to load and unload the jig.

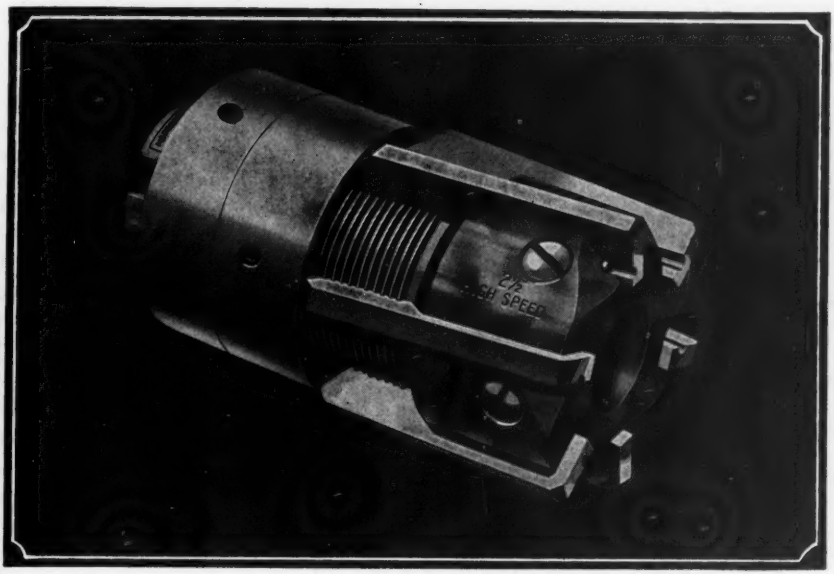
The work should be located as near the base of the table as possible, in order to obtain a maximum of rigidity and should also be as near the column of the machine as is convenient. Pressure applied to a drilling or milling machine table at a point some distance from the column may cause the table to sag, with the result that milled surfaces will be slanting or drilled holes will not be square with the locating surface of the work.

Clamping the Work

As a means for operating quick-acting clamps, air is coming into leadership. It is positive, quick, easily varied in pressure, can be utilized to remove chips, and can be arranged in such a way that the exhaust will clean the jig. Cam-operated devices are also fast and should be used in preference to screws unless cost dictates the cheapest kind of clamp. In many cases spring pressure will suffice to hold the work, a common example being the type of drill jig in which the work is nested in the base where the bushing plate, carried up and down with the drill head, holds it while the drills are cutting. Lately the practice of utilizing the indexing motion of the table to clamp the piece has been developed, notably on vertical millers. Local conditions govern the style of clamp that should be used, but in general the clamps should (a) be few in number, (b) not take the thrust of the cut, (c) not allow the work to spring or slide, (d) be held away from the work when same is unclamped, (e) grip as near to cut as possible, and (f) not endanger work by proximity to cutters.

The Jig Body

Having determined the means of locating and clamping the work, the body of the tool can be drawn. If it is to be a casting, be sure that it is strong enough to overcome vibration and breakage, yet light enough to be handled. If necessary, provide rock-



Ream True, Uniform Holes *and* Cut Cost per Hole

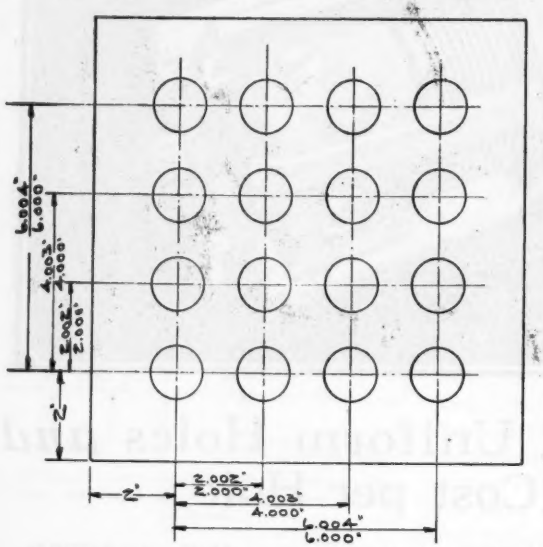
McCrosky-SUPER Device for locking blade in reamer body. It is located in front of cutting edge. It forces the blade toward the back and bottom of the slot. Because it works with and not against the cutting thrust, the blades stay tight and rigid in the body.

EVERY set of blades in a McCrosky-SUPER Adjustable Reamer gives the service of ten or more reamers of the non-adjustable type. When the blades have been worn undersize in one position, the reamer can be brought back to size by adjusting the blades forward and regrinding. When the blades are completely worn out, a new set can be inserted in the original body, which is hardened to protect it from damage. You can measure the economy of a McCrosky-SUPER Reamer by the true, uniform holes it produces during a long life. Bulletin No. 11-A tells the whole story. Send for a copy.

McCrosky Tool Corporation
Meadville, Pa.

McCrosky-SUPER Adjustable Reamers

ers, eyebolts, hand openings or other means of handling, for nothing is more dangerous and wasteful of time and labor than a heavy, awkward jig. Strength and rigidity can be obtained by proper rigging without recourse to solid, bulky sections, which add ex-

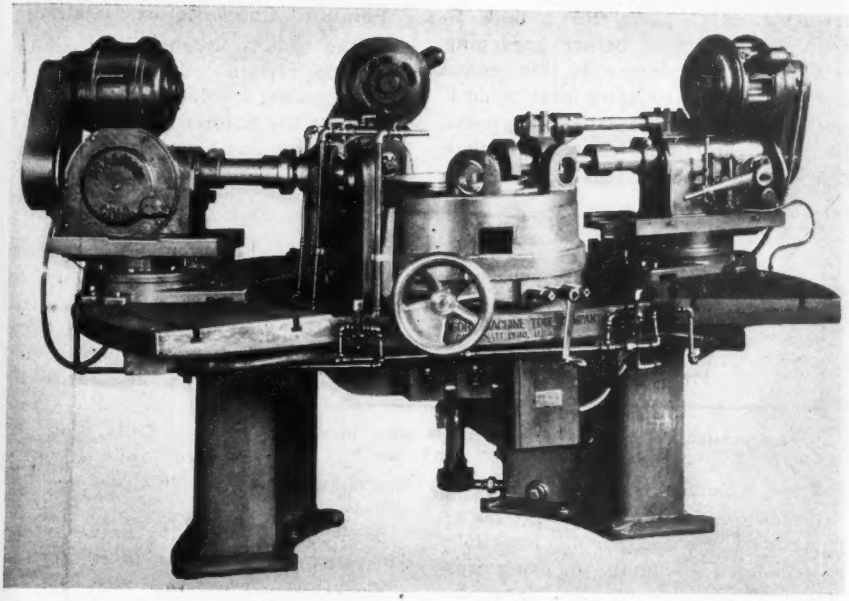


Dimensions should be given from one point, to avoid accumulation of errors.

pense and cause trouble in the foundry. It is hard to secure a good casting when all the metal is in one mass, because the inside of this mass is usually spongy or full of holes made by imprisoned air. Another very bad foundry condition exists when thin sections run into heavy ones abruptly. When the iron is poured, the thin section naturally cools first, with the result that it is contracting while the larger mass is still molten, causing a "pull" and consequent distortion which usually causes a crack. Narrow ribs should therefore be merged gradually into the heavy part if the latter cannot be cored to produce the ideal uniform section. Another characteristic of castings is their tendency to warp out of shape after several months. This tendency may be overcome somewhat by seasoning, or by taking a skin cut off the casting in the machine and then allowing the casting to set in the yard for a couple of weeks. For a real precision tool, however, it is a good stunt to provide for relocation of the main parts, in order that the tool may be lined up again when the casting has finally "set."

The essential thing in the pattern is to make certain that it can be molded easily by avoiding loose pieces, special coring, and deep, narrow pockets. The latter leave a long, weak column of sand in the mold, when the pattern is removed, which crumples when the stream of iron hits it. By the exercise of a little skill, it is often possible to devise a pattern that will form its own cores when split with one half in the cope and the other in the drag. Unless it is to be used frequently, the pattern should be a rough, or jig pattern, by which is meant a cheap piece intended for use in producing a few castings only. There is no need for several coats of shellac, leather fillets, and expensive touches on a piece that may never be used again.

Generous radii should be specified, as it is difficult to cast pieces with sharp corners, due to the fact that metal never quenches evenly in a square corner. This point should be remembered also when designing



WHIRLWIND AVIATION ENGINE crank cases rough bored, finish bored and tapped on above three-way **BRADFORD DRILLING and TAPPING MACHINE.** This machine handles 5, 7 and 9-cylinder crank cases and floor to floor time is as follows: 5-cylinder, six minutes; 7-cylinder, seven minutes; and 9-cylinder, eight minutes.

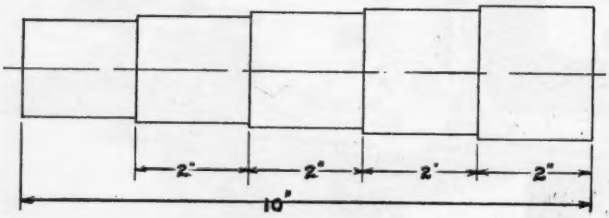
BRADFORD DRILLING and TAPPING MACHINES designed and built to fit your particular production job. Send us your blue prints or samples today and let our Drilling Engineers give you a production estimate on your parts. Let us reduce your drilling and tapping costs.

The BRADFORD MACHINE TOOL COMPANY

659 EVANS STREET **CINCINNATI, OHIO**

Precision Lathe Builders Since 1840

hardened steel parts, for a note to remove all corners before hardening will save many pieces. In this regard it is interesting to know that a hardened shaft with a radial relief groove has a greater tensile strength than one with a square "neck."



One dimension can be omitted on a straight piece, providing the overall dimension is given.

Details of the Jig

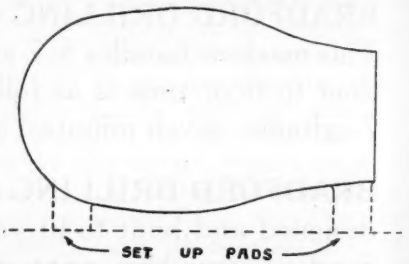
It is undoubtedly easier to draw parts to even dimensions, but there is a decided advantage in using fractional dimensions. A piece 2x4x6, for instance, has to be made from 2½x4½ inch stock, whereas it could have been cut from 2x4-inch steel if it had been made 1⅞x3⅞ inches. Any steel company will furnish lists of standard sizes to draftsmen, who, by referring to these lists, can dimension the pieces so as to save both material and machine time.

Hardened and ground pieces should not be driven directly into hardened and ground plates. It is much better to make the plate holes oversize, as it is then possible to harden the plate, drive shaft plugs into the oversize holes, and bore for the smaller pieces. When one part is a drive fit in another, something has to give and soft metal is more plastic than hardened material. When the detail is of odd shape, bosses or lugs should be added to give the toolmaker something to set up on when he is laying out the job.

Points to Check Before Detailing

If the tool is a drill jig, it should be made certain that (a) thrust of drill is against a solid surface, (b) the jig clears the column of the machine, (c) provision has been made for chips and cutting compound, (d) the drill can break through, (e) there is an undercut for the burr which will be left by the drill, (f) drill bushings are close to the work and twice the drill diameter, (g) standard drills can be used, and (h) base is relieved to rest on three or four points only.

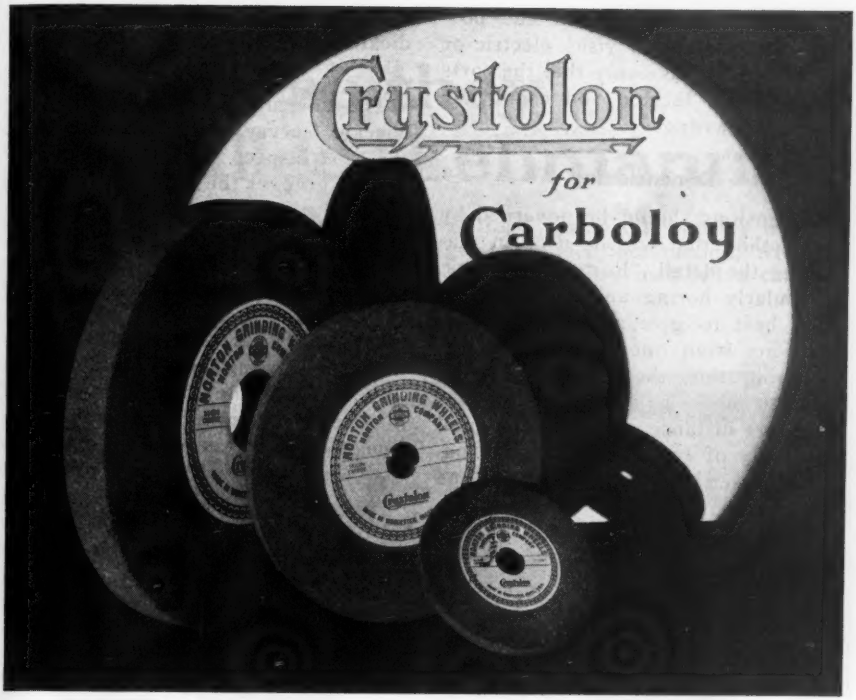
If the tool is a milling fixture, make sure that (a) work is held rigidly but not sprung, (b) fixture will not vibrate under cut, (c) provision is made for lining up and clamping, (d) setting blocks for cutters have been provided, (e) cutters and arbors will clear fixture, and (f) that work is close to table.



Provision should be made for resting the jig on the machine-table.

If the fixture is to be used for grinding, check (a) provision for adjustment and oiling, (b) protection against grit or emery dust, and (c) clearance of wheel, guard, and spindle.

If it is an assembly fixture, the



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ANNOUNCING THE WHEEL for grinding Carboloy, the new cutting tool material.

Crystolon is the abrasive recommended by the Norton laboratories and Carboloy Company, Inc., after many tests and experiments.

These wheels are available in all the required shapes and in grades for both roughing and finishing.

When ordering, specify Crystolon for Carboloy.

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W-235

designer should investigate the possibilities of using air vises, electric or air drills, and make sure that the parts are correctly located and cannot be assembled wrong.

Dimensioning

Dimensions should be governed by the method that will be used in machining the detail. For certain work, particularly boring and milling, it is often best to give all important dimensions from one hole or surface. By doing this, the machinist is enabled to move his table up and over the exact distance, and there is small possibility of errors accumulating because all settings are taken from one base point.

Holes that are on a radius can be dimensioned from each other in degrees if the machining is to be done on a dividing head, but if the piece is to be clamped to a table which has only vertical and horizontal adjustment, the figures should be given up and down from the center line.

In giving dimensions in decimals, the maximum tolerance should always be included. Generally plus or minus .010 inch is assumed on fractional figures, but if a wider latitude is possible, notice to this effect should be placed on the detail.

Each detail should carry overall figures to avoid errors in adding in the shop, and the least important dimension in the chain should be omitted. For example, if a shaft has five different diameters, the overall and four lengthwise dimensions only are necessary.

Another much-discussed question is that of finish. It is obviously wasteful to put a high polish on parts that are machined for clearance only; to avoid this waste of time the letters HF, MF and RF may be used to indicate high, medium, or rough finish.

Checking

The ancient custom of having the checker survey the requirements of the tool, inspect the details thoroughly, and go over the quantities and material is still in vogue, chiefly because the belief prevails that it is impossible to tell where a mistake is liable to occur. As a matter of fact, a little research and a record of past errors will show where most mistakes are made. With this data a guide can be prepared for the checker, who will inspect the drawing and mark each item on the list as he does so. Such lists are standard forms in large tool shops, and one that can be adapted to the needs of any shop can be made up very cheaply. Such a list can also be applied to large jobs and special machines where the checker usually makes a final assembly from the details. On jobs of this kind, the original layout is changed and rechanged so often during the detailing process that a new assembly is usually necessary. If a piece can be drawn, it has enough dimensions on it to machine so that this method catches any omission of dimensions. It also gives the checker an opportunity to inspect each figure, and to suggest and incorporate refinements in the design.

Grinding Tungsten Carbide

(*Continued from page* 18)

advisable to lap the cutting edge with diamond dust.

The angles at which the tools should be ground for cutting various kinds of material are somewhat different than those commonly used in grinding tools of high speed steel. The chart shown above gives the angles that have proved generally satisfactory for the materials listed.

—and so they installed "Lehmanns"

THE officials of a large western railroad (name on request) were selecting equipment for a new large shop under construction. After comparing the various types of lathes offered, they installed a complete battery of "Lehmanns."

Here is one of the reasons why:

The "Lehmann" Geared Head, giving 16 speeds through only 10 gears, is compact and shapely and provides a higher gear ratio than any other lathe built. Speed range permits operator to maintain a more nearly efficient cutting speed at all times.

All headstock gears are of heat-treated alloy steel of a special grade. All shafts are alloy steel, heat-treated, and run on ball bearings. Shafts having sliding members are made with four keys milled integral with the shaft.

Spindle is of alloy steel and has hardened and ground bearings and runs in bronze boxes. There are two diameters on spindle nose (patented), both hardened and ground. The friction clutches (patented) provide, through conveniently located handles, both forward and reverse, or brake control. This mechanism operates through helical gears which are mounted on shafts having ball bearings. These clutches require no adjustment at any time and will always pull a little more than the load imposed. Forward and reverse engages and disengages readily and will pick up under full load with ease. The entire unit runs in oil bath.

Ask us to tell you more about the "Lehmann"

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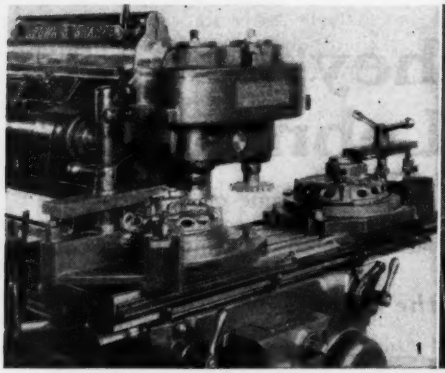

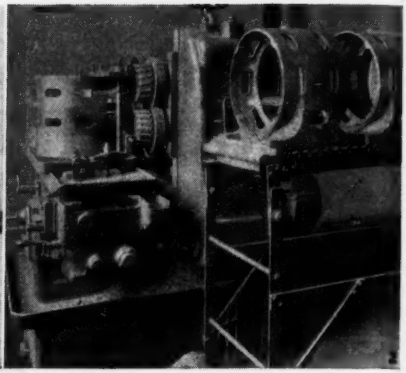

Fig. 1—The table on this Brown & Sharpe miller feeds and reverses by rapid traverse automatically. Fig. 2—Brown & Sharpe automatic miller equipped with a two-spindle attachment with which sixteen different sizes of frames can be milled.

Recent Developments in Milling Practice

By DONALD A. CLARK

THE design of equipment for mass production — especially on automotive parts — has apparently gone through three successive stages of development in the last two decades. Twenty years ago the equipment used in most metal manufacturing plants was of the standard variety; the engine lathes, milling machines, and other machine tools were of a more or less common design and variations in machining methods were obtained by the use of special tools, jigs, and fixtures.

As production increased and it became evident that many of the machines would be left set up for one operation indefinitely, special machines were designed and for a time it was deemed expedient to build a special machine for the performance of any operation upon which such a machine would save time or increase production. Frequent changes in the design of the product in order to effect improvements have rendered this system costly, and thus a demand has been created for machines of standard design which can be adapted, by means of a variety of machine units or attachments, to practically any job within the range of the machine and at a fraction of the cost of a new machine.

The milling machine, which is found wherever production methods are in use, is the outstanding example of this process of evolution. Instead of trying to build a complete new machine for each type of job, milling machine manufacturers are now building machines of standard basic design or of standard units, designed so that units of various sizes can be assembled to form a machine of the size and type desired, or to accommodate attachments to suit the various kinds of jobs that come to the miller.

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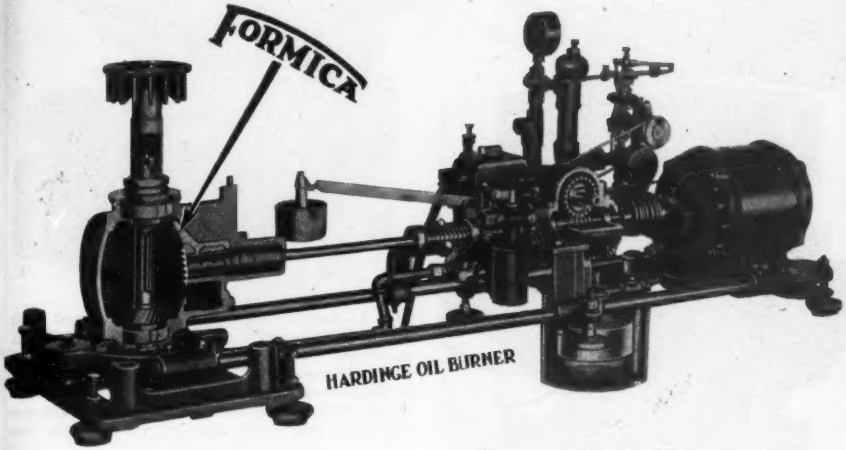

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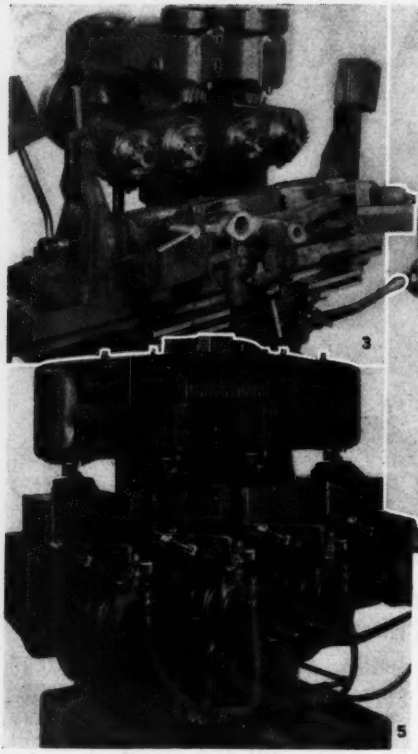


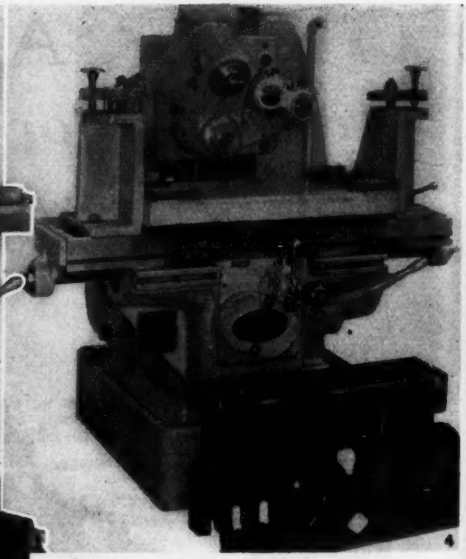


Fig. 3—Sundstrand "Rigidmil" equipped with cradle-type fixture for milling pads on exhaust manifolds. Fig. 4—Rigidmil with special head for milling pads on cylinder blocks. One pad is finished at an angle. Fig. 5—Milling hydraulic brake cylinders. The operator changes the pieces and moves a lever; the machine does the rest.

An example of a machine unit to which a special attachment has been applied is shown in Fig. 1. This is a Brown & Sharpe No. 21 automatic milling machine equipped with a special vertical spindle milling attachment and special work fixture for milling a slot for an oil ring in the end case of a motor frame. A feature of this set-up is that the fixture on the left end of the table will take care of three different diameters of parts, while the fixture at the right handles only one diameter of work. The reason for this is that the work is brought to the machine by conveyors and any one of four different sizes may come to the operator.

With this arrangement any piece that comes along can be placed on the machine, thus avoiding loss of time. The table operates automatically, feeding the piece on one fixture into the cutter, then reversing at high speed to bring the other piece up to the cutter, feeding the work in at cutting speed and reversing again. This cycle continues automatically. The spindles rotate continuously in one direction and the operator need only load and unload the fixtures as the work is finished.

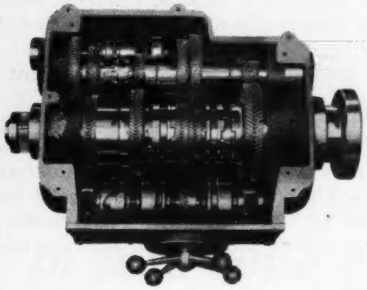
A different type of machine—the Brown & Sharpe No. 33 Automatic—is shown in Fig. 2 in use for milling the feet of motor frames. The ma-

MONOTROL

Geared Head

ENGINE LATHES

. . . . . offer these features—



THE Monotrol Headstock differs widely from the usual headstock design for geared heads—as Monotrol Headstock gears are always in mesh. Spindle speeds are obtained by the simple movement of one lever on a direct reading dial. This method entirely eliminates the possibility of stripping or clashing the gears while changing speeds during a cut.

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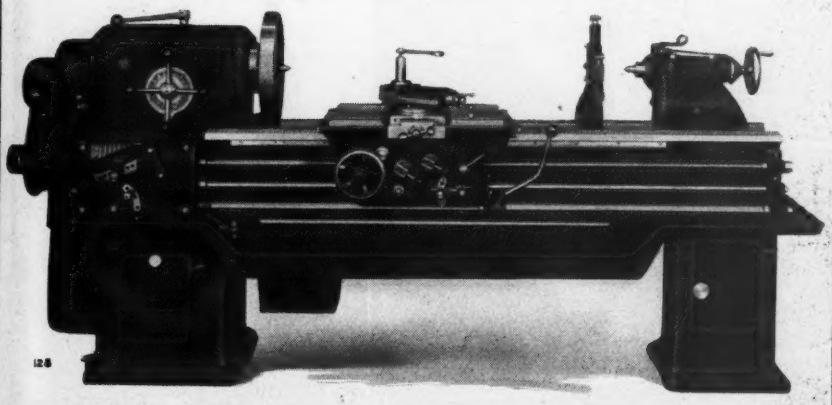
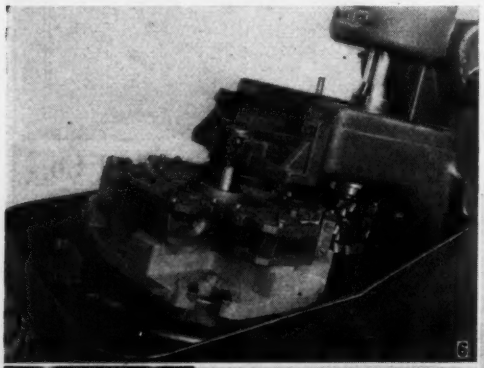


chine is equipped with a special two-spindle attachment with which it is possible to machine sixteen different sizes of frames. The machining of a frame of the size shown requires the use of both cutters, but the smaller type of frames are milled by using one cutter only. The operation of the table is entirely automatic, the fixture at one end being loaded while work on the other end is in process.

The illustration Fig. 3 shows a Sundstrand Rigidmil set up to mill, simultaneously, six pads on an exhaust manifold. Four horizontal and two vertical spindles, operating in a special head, provide for quick operation. The piece is held in a fixture of the cradle type, carefully counterbalanced for ease in handling. The illustration shows the cradle tipped outward for reloading; after the piece has been clamped, the cradle is tipped to the vertical position and locked. It is said that the production on this operation is 125 pieces per hour.

The use of a special head for milling at an angle is shown in Fig. 4. Here the Rigidmil is set up to mill five pads on a cylinder block, using a four-spindle special head. The five pads can be seen on the block, which has been removed from the machine in order to show both the work and the location of the cutter-spindles. The machines shown in Figs. 3 and 4 can be reverted to standard machines or adapted to jobs of different design by simply changing the heads and fixtures.

Another interesting development by Sundstrand is illustrated in Fig. 5. The work is a brake cylinder for a hydraulic four-wheel brake, four pieces being in process simultaneously. Each piece is held in a special two-jaw air-operated chuck, the chuck, in turn, being mounted on a rotary table.



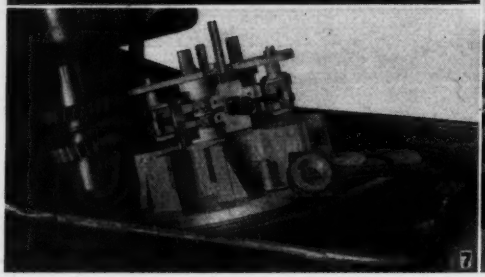


Fig. 6—Ohio Tilted Rotary Miller milling fork ends of steering spindles. Fig. 7—The same type of machine sawing caps from connecting rods and milling bolt bosses. Production—from 120 to 180 per hour. Fig. 8—Ohio Tilted Offset Miller straddle milling and slotting steering gear mast brackets. More than half the cutter is engaged in the work.

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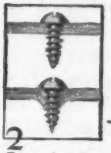

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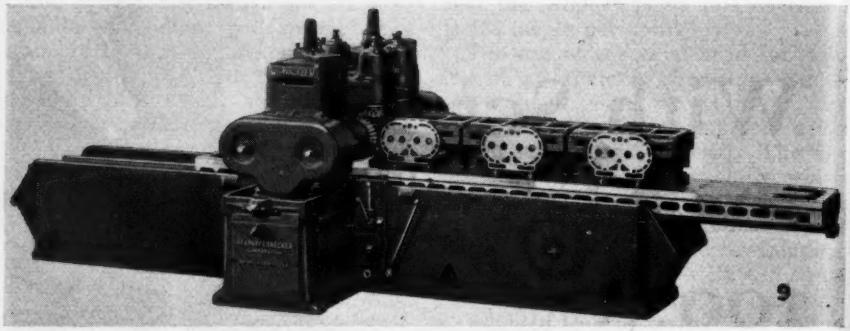


Fig. 9—"Mil-Waukee-Mil" Duplex milling machine finishing cylinder heads for tractor engines. Eight cutters are in operation on this job.

Each rotary table is independently driven, which makes it possible to load and unload one chuck while the other three chucks are in operation. The air equipment is arranged so that it serves two purposes—for clamping the piece, and to move the slide upon which the table is mounted to and from the cutter. When the piece has engaged to cutter to the proper depth, the table feed is automatically engaged, each piece being completed at one complete revolution of the table. Each spindle of the four-spindle head has independent vertical adjustment. This set-up is also an excellent example of the use of special equipment which can be discarded, if necessary, thus reverting the machine to a standard Rigidmil.

A machine that is especially adapted for high production on small parts is illustrated in Fig. 6. The machine is the "Ohio" Tilted Rotary Miller (made by the Oesterlein Machine Company), shown set up to mill the fork ends of steering spindles. This operation is performed after the spindle has been turned and ground, thus affording a finished surface by which to locate. Each piece of work is held in a fixture having four fingers, one of which is stationary, the other three being equalized in such a way that the piece is squared up before it is clamped. The fixture is mounted on a shaft that is secured in the base of the machine and also in the table and in the outboard bearing which ties the two ram guides together. The production on this operation is 120 pieces per hour, which could be increased considerably were it not necessary to hold a small fixed radius in the bottom of the cut. The cutters are cooled by forty gallons of coolant per minute.

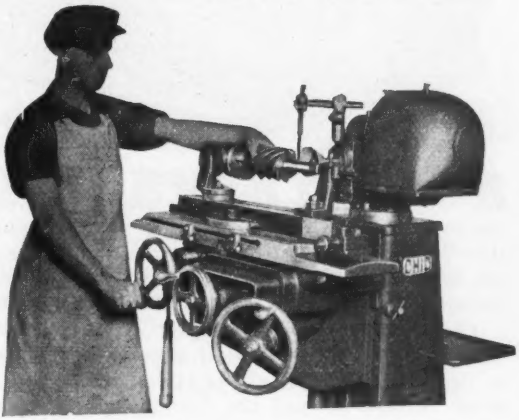
The illustration Fig. 7 shows the same type of machine equipped for sawing the caps off from connecting rods, and at the same time milling the ends of the bolt bosses. The fixture is of the four-station, indexing type, arranged so that the cutters mill one side of each of two rods in adjoining holders. In operation, the saw cuts through the steel first, passing into the babbitt only after the steel section has been completely cut through. Thus the steel chips are prevented from tearing through the babbitt. The rod is held in position by a stud in the bottom of the fixture, which passes through the small end of the rod, and by a clamp that is drawn up against the large end of the rod by means of a T-head draw bolt. Roller guide blocks guide the

No. 3 of a series of advertisements illustrating features of Oesterlein Ohio Grinders.

Difficult Jobs of Tool Grinding Made Easier!

Designed especially for the tool room, the Oesterlein Ohio Grinder is fitted to meet every requirement for the correct grinding of tools, cutters and reamers.

The extremely wide range of this grinder permits proper handling of many cutters often improperly ground. For example: when grinding side or straddle mills, if one face is ground and the mill then removed from the arbor and turned to grind the opposite face, improper alignment of the two faces frequently results. And you know what that means!



With the Oesterlein grinder, side or straddle mills are not removed from the arbor until after both sides are ground. This arrangement assures absolutely parallel grinding on both faces of the mill, gives positive straight line clearance and at same time secures a solid-backed cutting edge.

The wide range, combined with many other features, such as dual control (front and rear), independent in-and-out adjustment of wheel head and micrometer readings on periphery of hand wheel, make it easy to quickly secure accurate set-up and do a difficult job of grinding in the shortest possible time.

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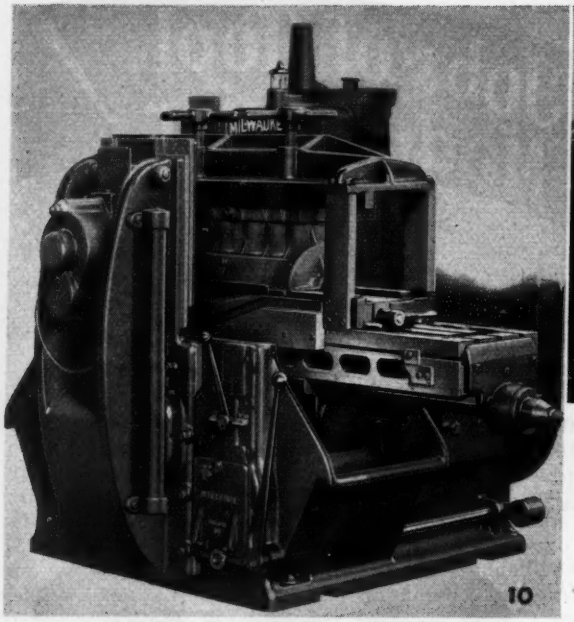

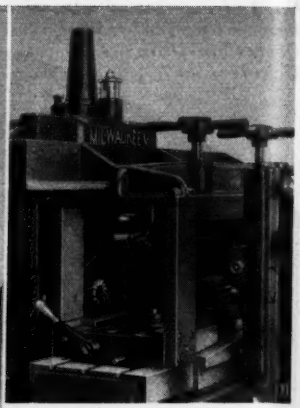

Fig. 10 — "Mil-Waukee-Mil" Simplex milling bosses on cylinder blocks. The cutter-spindles move in and out, and up and down, to avoid projections. Fig. 11—View showing location of cutters.

cutter-arbor as the cutter feeds in, also serving to support the arbor against strain. The production on this operation runs from 120 to 180 per hour, depending on the amount of metal in the rod.

The machine shown in Fig. 8 is an "Ohio" Tilted Offset Miller, which is so designed that the circular table and work revolve around the cutter, the table and cutter revolving in opposite directions. The operation in process is that of straddle milling and slotting malleable iron steering gear mast brackets. The equipment consists of an eight-unit fixture, which is provided with the latest development in automatic clamping. The bracket is held by a stud, upon which it is placed, the clamping being accomplished by means of a swinging clamp carrying an equalizer and operated by a wedge-shaped draw bolt, which in turn is drawn to the body of the fixture by means of a wedge on the end of the clamping plunger. A spring pusher automatically shoves the plunger in and clamps the piece as the table revolves, the plunger being withdrawn by a drift after the operation has been completed.

The method of building standard units which make it possible to assemble a machine that will be particularly suitable for the job in hand has been developed to an interesting point by the Kearney & Trecker Corporation. A complete series of columns, beds and tables is made in standard sizes, all of which are interchangeable, thus making it possible to combine columns of any height or design with beds and tables of any width or length. The idea is well-illustrated by the machine shown in Fig. 9, which is a "Mil-Waukee-Mil" Duplex built of a standard table and two standard columns that are fitted

15 TRACTOR FRAMES DRILLED, REAMED AND TAPPED EVERY HOUR

THE two machines illustrated above are used in one of the country's largest tractor plants for drilling 28 holes, reaming 6 holes and tapping 18 holes in the top of a large tractor frame. The use of a track and trunnion fixture which was provided by Natco, permits the performing of all operations under both machines with one handling of the piece.

This installation which includes one standard Natco Hydraulic Multi-driller and one special vertical Natco Multi-tapper shows another example of Natco Greater Production equipment being used to lower production costs.

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with four-spindle combination heads. The machine is used to finish cylinder heads for tractor engines, tandem cutters taking the roughing and finishing cuts on the surface of each head while tandem vertical spindles provide for milling the exhaust ports in the same operation. Thus eight cutters are employed, completing both the roughing and finishing cuts on two surfaces of each casting, at a single pass.

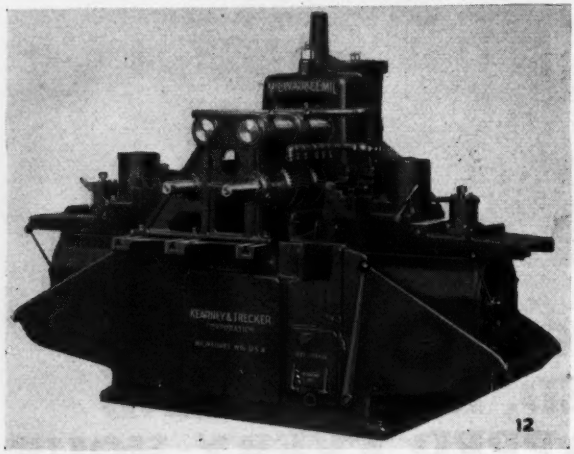

Fig. 12—The clamping, rapid traverse, feed, and reverse are automatic on this job. All the operator has to do is to change the work.

Another excellent example of the versatility of this type of equipment is illustrated in Fig. 10. The machine is a "Mil-Waukee-Mil" Simplex, arranged to mill five bosses on two sides of a cylinder block at a single pass. There are two cutter spindles—shown in Fig. 11—for milling bosses on the rear side of the block. The main spindle, carrying the large cutter, is mounted rigidly in the head. The lower spindle, at the left, is constructed to automatically recede at a pre-determined point in the cycle in order to avoid the bell housing flange of the casting. Similarly the cutter spindle in the outer head must raise to clear a projection, and then drop down to mill two bosses. Both of these auxiliary spindles—one moving in and out, the other moving up and down—are automatically cam-operated.

The combination of "Mil-Waukee-Mil" units shown in Fig. 12 includes a Simplex bed with two tables mounted in dovetail slides. Reciprocating motion is obtained by means of drum cams bolted to either end of the bed. The supplementary head carries two spindles, each with its own gang of cutters which revolve in opposite directions so that the cutting is always down toward the table. The machine is set up to machine steering knuckles, which are processed in pairs. With two pieces clamped in the fixture, the operator engages the starting lever at the end of the machine. The table slide advances at fast speed until the work is within ¼-inch of the cutters, during which movement it trips an automatic air valve that clamps the work. The work is fed into the cutters at cutting speed until the proper depth is reached, then the table stops and retreats by rapid traverse to the starting position. During the return movement the automatic air valve is again tripped, thus releasing the clamps. During this time the same operation is being performed at the other end of the machine, each table slide operating independently of the other so that one fixture can be reloaded and the operation started regardless of the position of the other unit. Trouble with one unit will not interfere with production on the other.

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The Nature and Properties of Iron and Steel. IV.

By GEORGE M. ENOS
Assistant Professor of Metallurgy, University of Cincinnati

This is the fourth article of the series, and deals with the physical and mechanical properties of iron and steel. The fifth article will deal with the constitution of steel and its relationship to heat-treating problems.

AFTER the steel has been rolled or forged to shape in the form of bars, rods, and other shapes, as described in the third article, further work must be performed in order to produce tools, fixtures, machine parts, and the like. Machining operations will not be discussed in this series of articles, however, except as they are affected by the properties of the metals. In order to develop certain qualities in the metal that will fit it particularly for the work it has to do, it is frequently necessary to heat treat steel before or after machining. A brief summary of the usual heat-treating operations is given in Table I. The material in this table is drawn in part from detailed

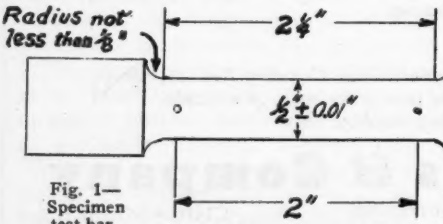

Fig. 1—Specimen test bar.

definitions that have been prepared by representatives of the American Society for Testing Materials, the Society of Automotive Engineers, and the American Society for Steel Treating for use in the A. S. S. T. Handbook.

It will be noticed that the purpose of all heat-treating operations is to change one or more of the physical properties of the steel. Before discussing the heat-treating operations in detail, it may be advisable to define and discuss briefly the physical and mechanical properties of metals, with particular reference to the properties of steel.

Various metals are selected as materials for manufacturing purposes on account of certain properties which these metals contain. In the case of steels, some of these properties are fixed, while others may be varied through a considerable range by the application of heat, followed by various methods of cooling from predetermined temperatures in air, water, oil, or other quenching media.

Physical Properties of Metals and Alloys

The **density** of a substance (mass per unit volume) is sometimes confused with **specific gravity.** If the density is expressed in grams per cubic centimeter, then the density is numerically equal to the specific gravity. Metals are, in general, relatively heavy substances. Metals are opaque under ordinary conditions. Metals in the liquid state,

TABLE I.

Summary of the Principal Heat Treating Operations as Applied to the Heat Treatment of Steel.

OPERATION	PURPOSE*	REMARKS
Annealing means the heating and cooling of a solid material.	To promote softness. To reduce or remove stresses. To alter physical properties. To refine the crystalline structure.	Annealing usually implies a relatively slow cooling. There are several types of annealing, such as Full Annealing, Normalizing, Malleabilizing, Tempering, etc.
Hardening means the heating of the steel to within or above the critical temperature range, and quenching.	To increase strength. To improve cutting properties. To improve the resistance of the steel to wear, to impact, or to penetration. To refine the crystalline structure.	Quenching means immersing to cool. The immersion may be in liquids, gases or solids. Some hardening may also be secured by cold work, but this should not be confused with hardening by heat treatment.
Tempering means to reheat the steel, after hardening, to some temperature below the critical range. The rate of cooling is unimportant.	To release stresses incurred during hardening. To decrease hardness.	"Drawing" is a term equivalent to Tempering. "Tempering" should not be used to refer to the two operations, hardening, followed by tempering, as this usage is confusing.
Case Hardening refers to the carburization and subsequent hardening, by proper heat treatment, of an iron base alloy such as steel.	To secure surface hardness in the "case," backed up by a tougher "core."	Carburizing (Cementation) means that carbon is added to an iron base alloy, by heating the metal below its melting point in contact with carbonaceous material. The carbon content of the surface layer is increased, and this layer is called the "case." The inner portion, not enriched in carbon, is the "core."

* The purpose of any operation may be any one or more of the items listed. In some cases any one purpose cannot be accomplished without changing several physical properties.

or when burnished or polished, have the power to reflect light to a considerable extent; this characteristic is termed **luster.** Most metals are silvery white or gray in **color,** but there are distinct variations in tint with different metals. Thus gold is yellow, and copper is red.

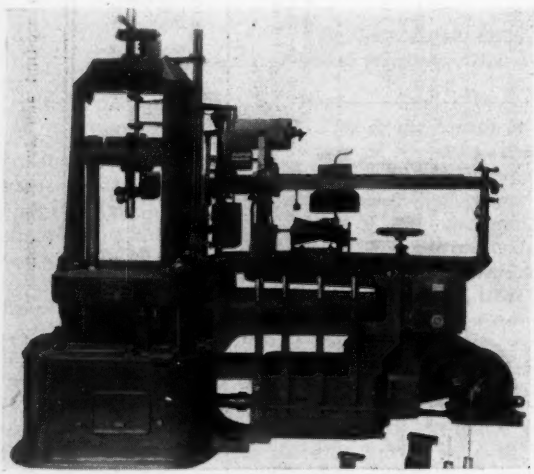

Fig. 2—Tinius Olsen Universal Testing Machine.

Metals are usually **good conductors of heat.** The quantity of heat required to raise the temperature of a unit mass of substance one degree is termed its specific heat. Metals, like most substances, expand upon being heated. Metals are **good conductors of the electric current.** The ratio of the thermal conductivity to the electrical conductivity at any given temperature is nearly the same for most pure metals. The evolution of heat when metal changes from the liquid state to the solid, and the absorption of heat upon melting, are phenomena which will be further discussed in the next article. The temperature at which the metal changes from the solid to the liquid is known as the **melting point;** when the change is from the liquid to the solid, the temperature indicated is the **freezing point.** The freezing point and melting point are not necessarily identical, however. The foregoing properties are subject to little, if any, changes, whereas many of the mechanical properties may be changed by heat treatment, or by cold or hot work.

Mechanical Properties of Metals and Alloys

When an external load is applied to a body, a system of internal forces is set up. These forces, which are known as stresses, transmit the load to adjacent parts of the body. Stress is measured in terms of force per unit area. Stresses differ in intensity and direction, but not in kind. A simple pulling apart of a bar, the ends being displaced in opposite directions, sets up a tensile stress. The tensile strength, or resistance of the metal to tensile stress, may be measured by pulling apart a bar such as is shown in Fig. 1, using a testing machine of the type shown in Fig. 2.

The term "compressive strength" is self-explanatory. The application of forces from opposite directions which meet and pass each other, thus causing one portion of the metal to slide past another, is called **shear.** The blanking or forming of sheet metal is an example of this type of force. Any stress tends to produce relative displacement of the constituent parts of the body. A condition of stress within the body results in a change of the external form which is known as a **deformation.** If the stress is small enough, the body will be sufficiently elastic to return to its

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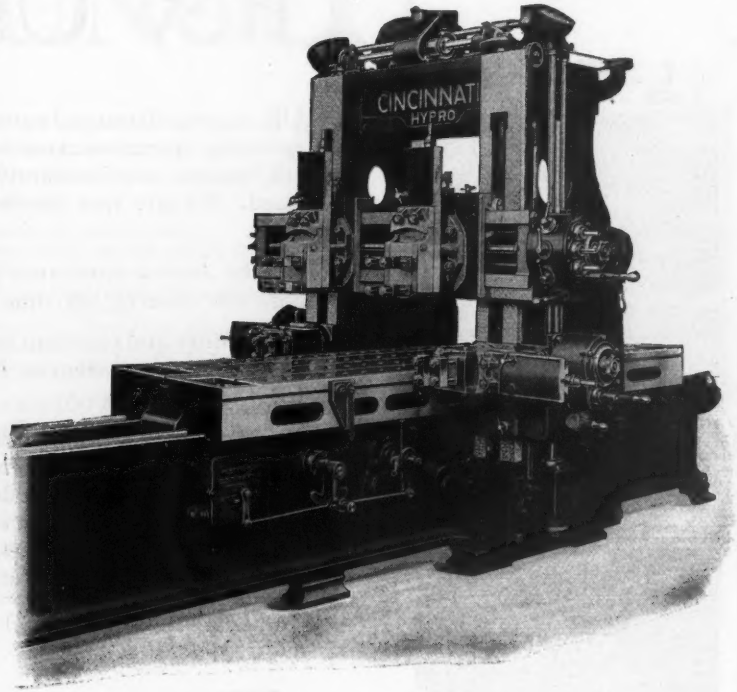

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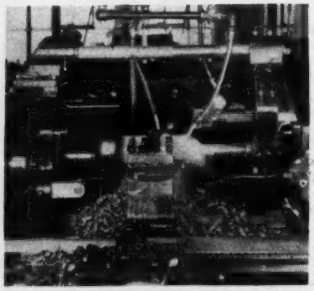

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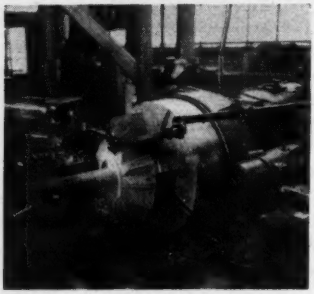
OPERATION: MACHINING FOLLOW RINGS FROM 4" TUBING
MACHINE: WARNER & SWASEY NO 3 TURRET LATHE.
MATERIAL: CARBON STEEL.
SPEED: 110 R.P.M.
FEED: .032 INCH
CUTTING LUBRICANT: ONE PART SUNOCO TO THIRTY PARTS WATER.
RESULTS: THE BEST THEY HAVE EVER USED. NO SKIN INFECTIONS. NO SEPARATION. NO RANCIDITY. IN USE LAST TWO AND A HALF YEARS.



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OPERATION: BEVEL GEAR FOR STEAM SHOVEL
MACHINE: LIBBY LATHE.
MATERIAL: .40—50 CARBON STEEL.
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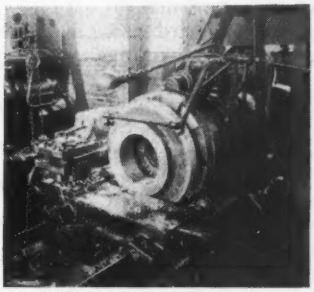
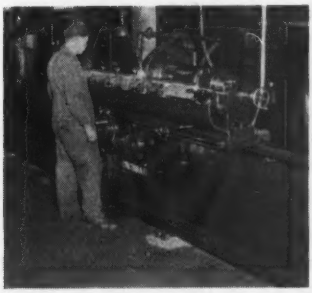


COURTESY NATIONAL FOUNDRY CO ERIE. PA
OPERATION: FACING 22 INCH BEVEL GEAR WITH 14 INCH HUB.
MACHINE: GISHOLT TURRET LATHE.
MATERIAL: .40 CARBON STEEL
SPEED: 8 R.P.M
FEED: ⅛ INCH CUT—⅛ INCH
CUTTING LUBRICANT: ONE PART SUNOCO TO TWENTY PARTS WATER



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original shape upon removal of the stress. If a permanent deformation results, the stress was great enough to permanently change the external shape. It is obvious that a deformation may be accomplished by tensile stress, compressive stress, or shear, or a combination of these stresses.

In general, the resistance a metal offers to a permanent deformation is known as its **hardness.** But when the deforming force is well-defined, such as a tensile pull, then the resistance offered is measured in terms of strength. When a specimen is pulled apart in tension, the maximum load reached during the test, divided by the original cross-sectional area of the specimen, gives a value (in lb. per sq. inch) known as **tensile strength.** In a like manner, the maximum pressure required to break a specimen in compression, divided by the original cross-sectional area, gives the **compressive strength.**

If a bar is pulled apart in tension and the ends are then fitted together, it will be found that the bar increased in length before the break occurred. The extra length is expressed as a percentage of the original length.

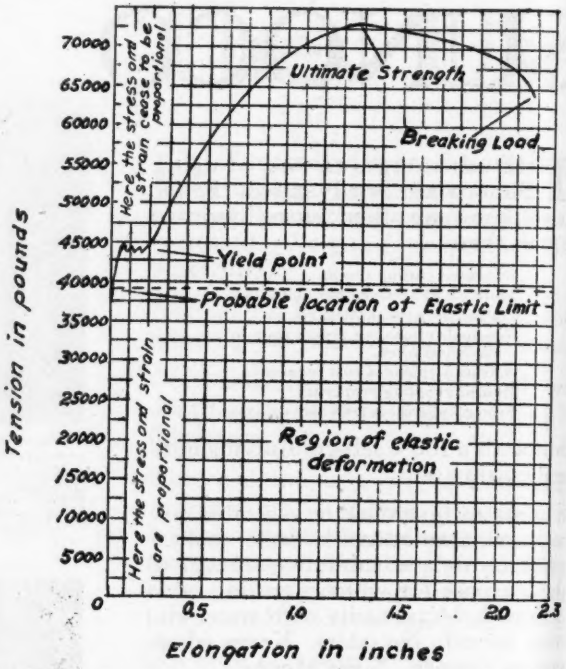

Fig. 3—Graph showing relationship between stress and strain for a structural steel. (From "Making, Shaping and Treating of Steel," Carnegie Steel Co.).

The highest stress to which a material can be loaded in tension without producing a permanent deformation is called the **elastic limit.** The **yield point** is the stress at which a very definite and perceptible increase in length occurs for a slight increase in stress. (See Fig. 3; a stress strain diagram for structural steel). Maximum strength, ultimate strength, and breaking strength are terms used as the equivalent of tensile strength. **Elongation** is expressed in percentage. **The reduction of area,** also expressed in percentage, refers to the difference in the area of a cross section of the specimen at the point of rupture, before and after breaking the bar in tension.

Ductility refers to the ability of a metal to extend to considerable length under tension without rupture. **Malleability** is that property of a metal which permits of a considerable amount of deformation by an external force without rupture. **Tough-**

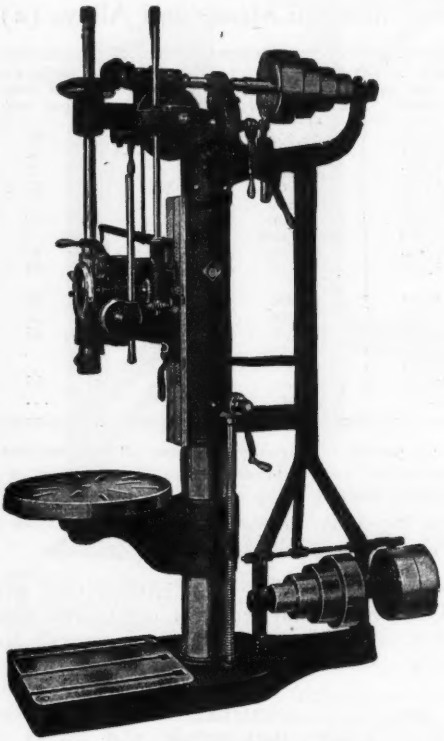

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TABLE II.*

Some Mechanical Properties of Common Metals and Alloys (a)

	Tensile strength, pounds per square inch		Elongation per cent in 2 inches	Reduction of area, per cent
	Ultimate	Elastic limit		
Aluminum (cast)	12,500	8,000	20	35
Brass 70-30	54,000	45,000	16	20
Bronze 90-10	34,000	26,000	8	7
Copper (soft)	33,000	8,000	50	60
Duralumin	61,000	36,500	19	...
Iron	45,000	22,000	50	70
Lead	3,000	Negligible	406	...
Monel metal	90,000	51,000	42	65
Nickel	75,000	25,000	45	60
Steel:				
Structural	60,000	35,000	25	50
High-carbon	125,000	75,000	10	20
Alloy	240,000	220,000	12	45
Stellite	116,500	50,000	3	...
Tin	5,500	.....	43(?)	...
Tungsten (wire)	230,000	.....	3	65
Zinc	22,000	Low	40	...

(a) The data in this table must be interpreted intelligently, because all the mechanical properties of the non-brittle metals and alloys are very dependent upon the condition of the metals, so that the choosing of a representative figure is partly a matter of opinion.

* Abstracted from Table II, Engineering Metallurgy, by Stoughton & Butts, McGraw-Hill Book Company.

ness refers to the total amount of energy or work required to break a material. Brittleness is the opposite of toughness, as a comparatively small amount of force is required to break a brittle material. **Resilience** refers to elastic energy which may be released. Ductility, malleability, toughness, and brittleness are qualitative rather than quantitative terms. **Torsion** refers to a load applied in such a way as to produce a twist. It is obvious that deformation may be caused by torsion. **Fatigue** will occur in a metal that is repeatedly stressed below the elastic limit. Fatigue will cause a metal to fail under less load than would be required if it had not been so stressed. The term "crystallization" is often incorrectly used to describe a fatigue break. The term implies that either the metal was not crystalline before the break, or that new crystals were formed, either of which is correct.

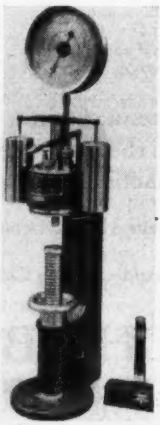

Fig. 4—Brinell Testing Machine.

Some of the mechanical properties of the more common metals and alloys are given in Table II, and Table III shows some average values for strength, stiffness, and ductility of iron and steel. In this table the effect of heat treatment and work on iron and steel are clearly shown.

In order to obtain data such as are given in Tables II and III, a considerable amount of testing equipment and special test specimens are required. (The hardness numbers obtained from various testing instruments are not given in the tables). Hardness values, like strength values, will vary with the composition and with the

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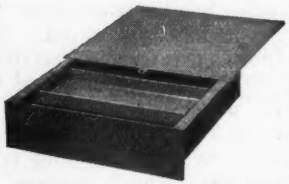

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TABLE III.

Average values for strength, stiffness, and ductility in iron and steel. The values given in this table are based on test data from various material-testing laboratories.

MATERIAL	Tensile strength, lb. per sq. in.	Shear strength, lb. per sq. in.	Elongation in 2 inches, per cent
Gray cast iron	20,000	(a)	Slight
Malleable cast iron	45,000	(b)	7.5
Commercial wrought iron	50,000	35,000	35.0
Steel, 0.10% carbon; rolled metal	50,000	35,000	45.0
Steel, 0.20% carbon; rolled metal	60,000	45,000	35.0
Steel castings	60,000	45,000	30.0
Steel, 0.40% carbon; rolled metal	90,000	65,000	20.0
castings	80,000	60,000	15.0
Steel, 0.60% carbon; rolled metal	115,000	85,000	14.0
Steel, 0.80% carbon; rolled metal	135,000	100,000	10.0
Steel, 1.00% carbon; annealed rolled metal	150,000	115,000	5.0
Cold-rolled steel, 0.20% carbon	80,000	60,000	18.0
Structural nickel steel, 3.5% nickel	90,000	65,000	25.0
Chrome-nickel steel, 0.40 C, 1.5 Ni, 1.2 Cr. — As rolled	95,000	70,000	25.0
Chrome-nickel steel, 0.40 C, 1.5 Ni, 1.2 Cr. — Heat treated	145,000	105,000	15.0
Vanadium steel, 0.40 C, 1.00 Cr, 0.17 V; As rolled	85,000	65,000	28.0
Vanadium steel, 0.40 C, 1.00 Cr, 0.17 V; Heat treated	220,000	(b)	14.0

(a) Greater than tensile strength; under pure shear, cast iron fails by tension on an oblique plane. (b) Data lacking.

(NOTE: Table III is abstracted from "Materials of Engineering," by Herbert F. Moore, Published by McGraw-Hill Book Co., Inc., 1922.)

heat treatment. Hardness tests may be carried out on simple test specimens, or even on parts which are to be used in service. For this reason hardness testing machines are often found in machine shops. Hardness numbers bear a relationship to strength values, and hence can be used not only to check the actual hardness, but also to approximate the strength values.

The three **hardness** testing devices in most common use are the Brinell (Fig. 4), Scleroscope (Fig. 5), and the Rockwell (Fig. 6). In the Brinell test a hardened steel ball is pressed into the specimen to be tested. The standard ball is 10 millimeters in diameter, and the pressure, or load, is 3,000 kilograms. The Brinell hardness number is calculated from the diameter of the impression that is made in the material by the ball. The diameter of the impression is read by means of a microscope with a micrometer eyepiece, and the value as expressed by the hardness number is read directly from a chart.

The Shore Scleroscope measures the resilience of the material. A small weight (hammer), which consists of a steel cylinder that is ¼-inch diameter by ¾-inch long and tipped with a blunt diamond point, is allowed to drop from a standard height upon the specimen to be tested. It falls through a glass tube, at the back of which is a scale. As the hammer rebounds, the height reached by the top of the hammer is noted. The hardness number is read direct from the scale, if the instrument is of the visual type, as shown at the left in Fig. 5, or on a graduated dial if the instrument is of the recording type, as shown at the right.

Like the Brinell tester, the Rockwell instrument measures the resistance of the material to penetration by a hardened steel ball. The Rock-

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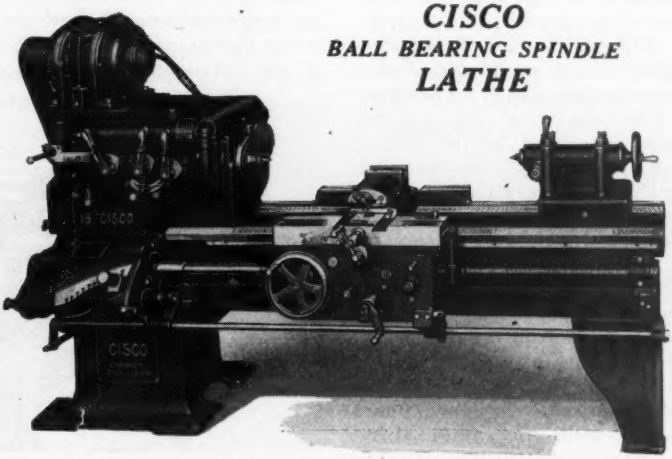

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well machine uses a 1/8-inch diameter hardened steel ball, and the force applied is 100 kilograms. Two superimposed impressions are made, one with a minor load of 10 kilograms, and a second with a load of 90 kilograms. The depth of the greater penetration, as caused by the second impression, is recorded on the dial. For very hard materials a diamond cone is substituted for the steel ball and a load of 150 kilograms is employed. Numbers obtained with the steel ball are read on the "B" scale, while those obtained with the diamond cone are read on the "C" scale.

Where only one testing instrument is available, the following relationships make it possible to approximate hardness and strength values which would be obtained by the use of other testing equipment. For Carbon Steels $M = .73\ B - 28$, and $M = 4.4\ S - 28$, where M is the ultimate strength in units of 1000 lbs. per sq. in., B is

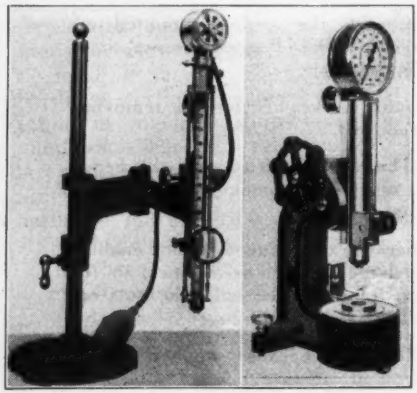

Fig. 5—(Left) Scleroscope—Visual Type. (Right) Recording Type Scleroscope.

the Brinell number, and S is the Scleroscope number. As an example, a plain carbon steel having a Brinell hardness number of 200 would have a tensile strength of approximately 118,000 lbs. per sq. in. ($.73 \times 200 = 146$. $146 - 28 = 118$. $118 \times 1000 = 118{,}000$.) The corresponding Scleroscope number would be 33, as the relationship between Brinell and Scleroscope numbers is given by $B = 5.6\ S + 14$. Another formula sometimes

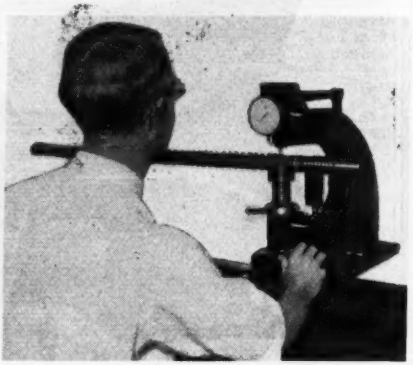

Fig. 6—Using Rockwell Hardness Tester to test broaches at National Broach Company.

used to compute strength values is Tensile strength, in lbs. per sq. in., $= 515 \times$ Brinell number. It will be noted that this formula will not give check results when compared to values obtained with the previous formula, nor would either calculation necessarily check actual test values very closely.

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The Kearney & Trecker Corporation, Milwaukee, Wis., has published their Catalog No. 36, which describes in detail the uses and adaptability of the "Mil-Waukee-Mil." The various combinations possible by the use of the various units which go into the construction of this machine are described and illustrated, and all the various parts of the machine are dwelt upon in detail. Diagrams in color show the course of travel of the lubricant, and similar diagrams illustrate the course of the coolant. All the necessary data is included so that the prospective purchaser can order the combinations of heads and tables according to his needs.

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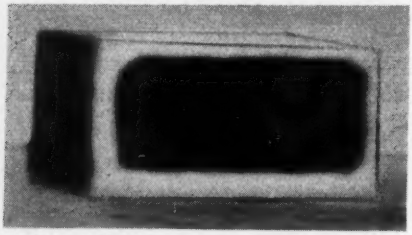
A Simple Tool Steel Test

By R. H. KASPER

MECHANICS have at times been puzzled to find that, although a piece of straight carbon tool steel showed extreme hardness when taken from the quenching bath, the hardness disappeared after several cuts had been taken on the grinder. Overheating in the grinding operation is frequently blamed, although slow and careful grinding, even with a coolant, seems to help very little, if at all. The reason, which is known to every steel man but is not generally known by the average shop man, is that straight carbon tool steel in the larger sizes will not harden entirely through the section.



Tool steel section after hardening, with end ground off to show case.

The hardness of straight carbon tool steel is determined by the rapidity with which it is cooled from the critical temperature, and on any but the smallest sections it is impossible to cool it with sufficient rapidity to produce hardness throughout the entire section. The result is a hard shell or case, while the core remains soft. The more rapid the cooling, the deeper will be the case. Various quenching mediums produce different results, depending on the rapidity with which it will dissipate the heat. Oil or air hardened alloy steels differ from straight carbon steels in that the change takes place slowly, making it possible to harden entirely through a heavy section.

The photograph shows a piece of 1.15 per cent carbon tool steel which was hardened to determine the depth of case possible with that size section. The steel was heated to a temperature of 1,450 degrees Fahrenheit and quenched in brine containing one pound of salt to one gallon of water, being permitted to cool in the bath.

After withdrawing from the quenching bath, the piece was broken and one of the fractured ends ground off smoothly. The ground end was then immersed for an hour in a 10 per cent solution of alcohol and nitric acid. After removing from the acid solution, the ground end was rubbed vigorously with a cloth soaked in clear, cool water. The effect of the acid solution is to etch the soft core more deeply than the hard shell, the lines of demarcation being quite distinct. The photograph shows the ground end after washing, though the difference in the colors is somewhat exaggerated, the soft core actually being what might be termed a very dark gray color while the hard outer shell assumes a very light gray color.

It will be seen in the photo that the case on the under side is somewhat thicker than on the upper side, indicating that the lower side cooled more rapidly than the upper side, probably due to the fact that it entered the bath first and was held closer to the bottom of the tank where the brine would naturally be

(*Continued on page* 82)

Apex Friction Chuck

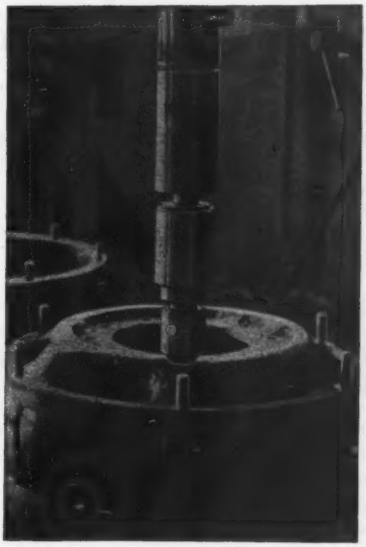
For Stud Setting

Guaranteed not to mar threads or twist off studs

Also used for nut setting and screw driving, large chucks for body, motor and axle assembly in automotive plants, small chucks having sensitive adjustment for radio and electrical instrument assembly.

Multiple Disc Drive—
Set to any desired tension—
Slips without slightest jar.

Write for complete catalogue describing APEX Quick Change positive and friction Chucks.



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Grand Rapids Tap Grinders

SPEED PRODUCTION

Because Taps Ground on Our Machines:

Cut Faster
Stay Sharp Longer
Produce More Work
Produce Better Work

Bulletin on Request

GALLMEYER & LIVINGSTON CO.
348 Straight Ave., S. W.
GRAND RAPIDS, MICH.

Ideas From Readers

This department is a clearing-house for ideas. If there is a "kink" or short-cut in use in your shop, send in a description of it. We will pay $5 for each one published.

Improving the Short Belt Drive

By R. H. KASPER

IT IS a well known rule that short belt drives should be avoided whenever possible. However, for a number of reasons, it is sometimes impossible to avoid short belt drives without costly or undesirable changes in machine design. A short drive necessitates excessive tightness of the driving belt, resulting in decreased life of both the belt and the bearings.

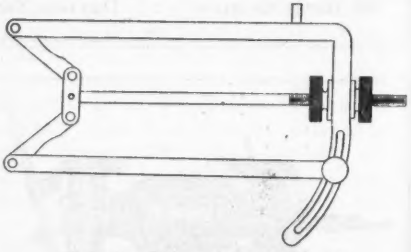
The illustration shows a method whereby short belt drives may be rendered more efficient without excessive tightness. The pulleys are belted in the usual manner with a belt sufficiently heavy to carry the load, a reasonable amount of slack being permitted on the side not carrying the load. A lighter and narrower belt is then stretched over the pulleys on top of the driving belt. A flexible and somewhat elastic belt, such as a chrome-tanned belt, is best for this purpose. In this manner, the heavy belt carries the load while the lighter belt, by virtue of its elasticity, merely serves to insure perfect contact of the driving belt with the pulleys. The lighter belt should be as narrow as possible; usually one half the width of the driving belt will be satisfactory.

The light belt keeps the driving belt in contact with the pulleys.

Adjustable Gage for Fitting Piston Keys

By J. H. HAHN

THE piston rods used on most locomotives are secured to the crossheads by tapered fits on the ends of the piston rods, the rods being assembled to the crossheads with tapered keys which must be fitted very accurately. A misfit key will in most cases result in an engine failure and engine failures are very costly. The gage shown in the drawing was designed to eliminate any trouble that might be experienced in obtaining a perfect fit on these keys.



Gage for fitting piston rod keys.

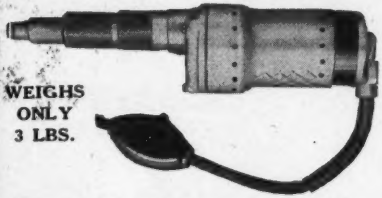
After the piston rod has been drawn

Three New Small Electric Tools

Thor

Electric Drills *and* Screw Drivers

Exceptionally speedy and light in weight. Ideal for radio, piano, phonograph, auto, furniture and electric appliance manufacturers. Capacity of drill, 3/16 in. Length overall, 9¼ in. Center of spindle to side of case is 11/16 in. Speed is 2,300 R.P.M.



WEIGHS ONLY 3 LBS.

Thor ULT for metal screws up to and including No. 8-32. Length overall is 11¼ in. Speed is 950 R. P. M.

WEIGHS ONLY 2¾ LBS.

Thor ULP for wood screws up to and including No. 8. Same as size ULT except speed, which is 485 R. P. M.

Try one of these small electric drills or screw drivers in your own plant for ten days free of charge. If its performance doesn't satisfy, return it at our expense. No obligation.

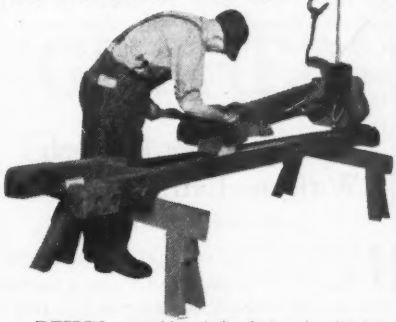
INDEPENDENT PNEUMATIC TOOL CO.

236 SO. JEFFERSON ST., CHICAGO

A better way

to grind heavy pieces

at lower cost



HERE'S a portable grinder designed and built for high speed snagging . . . for fast and easy grinding of heavy, ponderous pieces. Here's the Safety No. 18 Portable Grinder, strong and sturdy, finely balanced, light in weight, and simple in construction and operation.

Safety Portable Grinders are so versatile in scope that they can be profitably used in almost every foundry or machine shop. They are low in price and economical in operation. In hundreds of plants like yours they are saving hours of time and thousands of dollars every year.

SEND FOR DETAILED INFORMATION

Write today for complete information about the Safety "No. 18" and other Portable and Swing-Frame Grinders. They are manufactured in various sizes and types to meet different conditions and requirements. They are adapted for high or moderate speed wheels ... for many kinds of grinding . . . or for polishing on large work. Learn how they speed up production, cut costs, eliminate delays and build up big new profits. Find out how simple they are . . . how easy to operate. Just pin the coupon below to your letterhead and have your secretary mail it.

It would be helpful if you tell us your electrical specifications.

The Safety Grinding Wheel & Machine Co.

2314 *Columbus Ave., Springfield, Ohio, U. S. A.*

Please send me Bulletin S-28-1 regarding Safety Portable Grinders.

.....

(Name of Individual)

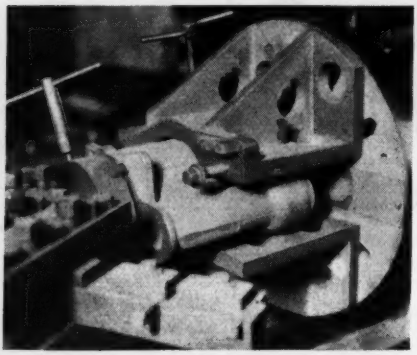
Pin this to your letterhead

up in position, the gage is inserted in the keyway and adjusted to the exact size of the opening. This size is then given to the machine operator as the correct size to which the key is to be made. The lug on the left side of the gage is to prevent the gage from sliding through the keyway while being adjusted. The gage is made of tool steel, hardened, and the dimensions for the class of engines on which the gage is to be used are stamped on the side.

Locating Work Properly With an Extra Chuck

By Wm. Kline

HAVING decided that the machining of oil pump bodies in a turret lathe could be handled better by using a fixture than by trying to hold the piece in an ordinary lathe chuck, we were confronted with the problem of locating all pieces centrally regardless of any extra stock that some of the pieces might have. Adjusting the screws in the fixture to bring each individual piece central took too much time. We finally solved the problem by putting a chuck on one side of the turret, in which the piece is gripped and held while the screws are adjusted to it in the fixture. The chuck-jaws grip the piece from the inside of a cored hole, thus equalizing the stock to be machined out. It is also much easier for the machinist to locate and clamp the piece in the fixture than would be the case if he had to hold it with one hand and try to clamp it with the other.

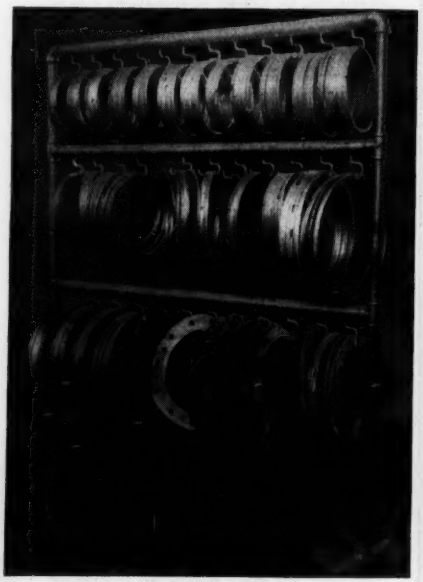


A chuck on the turret centralizes the piece and holds it for clamping in the fixture.

Keeping Packing Rings Handy

By Jos. C. Coyle

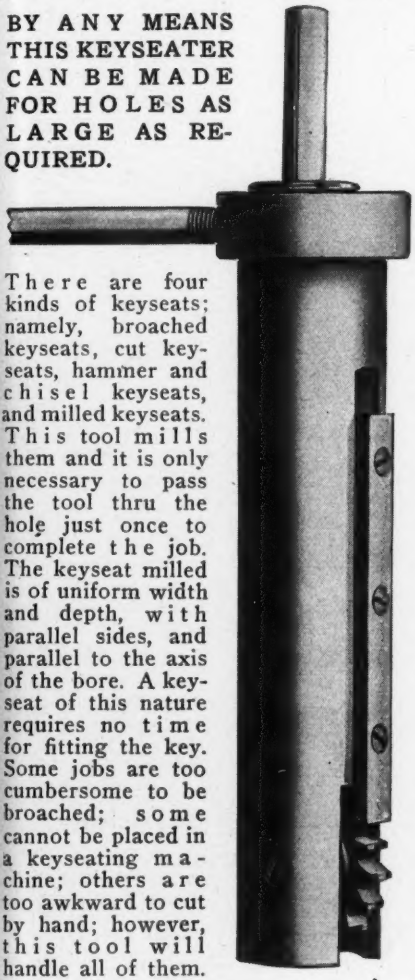
IN the overhauling and repairing of pumps at the Burnham shops of the Denver & Rio Grande Western railroad, considerable time is saved by having a supply of all sizes of piston rings and packing close at hand. This is achieved by the means of the rack shown here, constructed largely of 1½-inch pipe. Curved sections arranged crosswise at the bottom of each leg give the rack ample support,



Locomotive Packing Ring Rack

NOT MINIATURE

BY ANY MEANS THIS KEYSEATER CAN BE MADE FOR HOLES AS LARGE AS REQUIRED.



There are four kinds of keyseats; namely, broached keyseats, cut keyseats, hammer and chisel keyseats, and milled keyseats. This tool mills them and it is only necessary to pass the tool thru the hole just once to complete the job. The keyseat milled is of uniform width and depth, with parallel sides, and parallel to the axis of the bore. A keyseat of this nature requires no time for fitting the key. Some jobs are too cumbersome to be broached; some cannot be placed in a keyseating machine; others are too awkward to cut by hand; however, this tool will handle all of them.

Write for Catalog Q.

National Machine Tool Co.

2271 Spring Grove Avenue

CINCINNATI, OHIO, U. S. A.

There's a Lifetime of Wear in

"GUSHER"

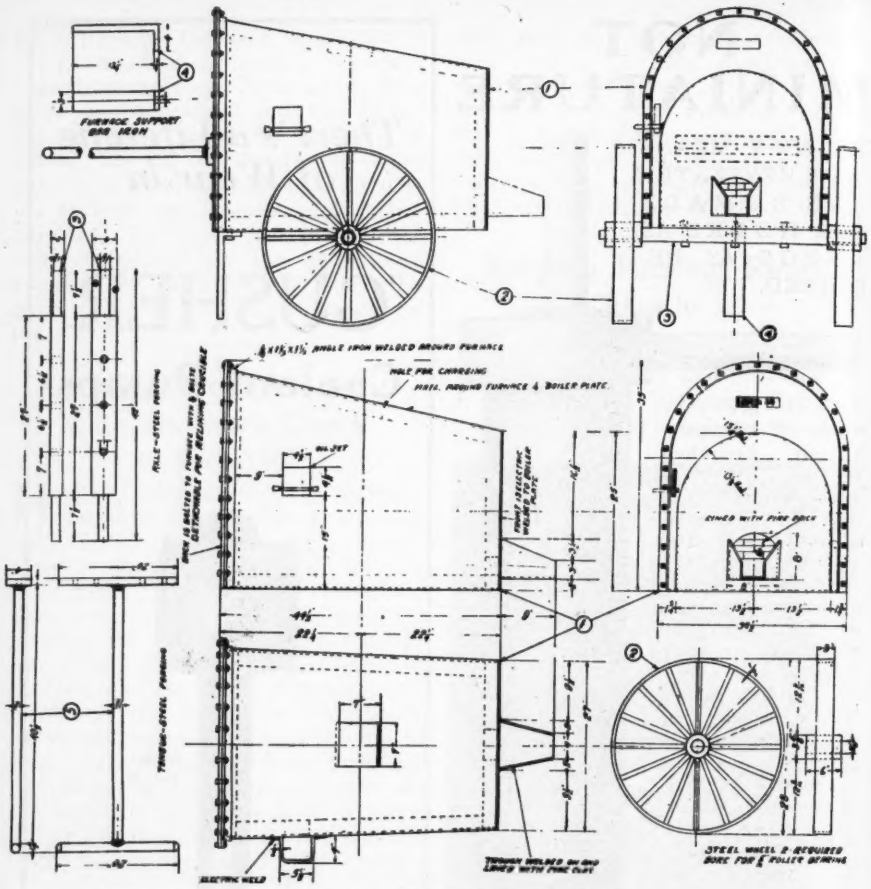
Coolant Pumps

MODEL U-L-O

The Ruthman Machinery Co.

Front and Pike Streets

CINCINNATI



Details of Portable Brass Furnace

and it may be moved about the department wherever needed. The rack is joined together with tees and elbows of pipe. It is four feet wide by six feet high, with three cross-bars.

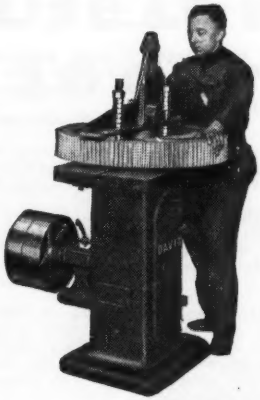
These cross-bars, made of smaller pipe, are enclosed in 6-inch sections of 2-inch pipe with a steel hook welded to each section. The hooks are forged in shape to hold several rings each, the size of the rings on each hook being plainly marked with paint on the front of the pipe to which it is attached.

Portable Brass Melting Furnace

By H. H. Hinson

NEARLY every large railroad has a large foundry where all steel and brass castings are made for the entire system. Lack of foundry facilities proves an inconvenience occasionally when a small brass casting is needed for emergency use, particularly since the practice of using steel liners on the wheel centers and pour-

(*Continued on page* 82)



The low cost machine

DAVIS KEYSEATER

FOR everyday shop work you need the versatile Davis Keyseater. It can be set up quickly for each item of a run of mixed work, and can be employed equally profitably on quantity production. Capacity in steel; keyseats 1/16 in. to 1 in. wide (also taper keyways) on hubs up to 12 inches.

COSTS LITTLE. DOES MUCH. TRY IT.
WRITE FOR ILLUSTRATED BULLETIN.

Davis Keyseater Company

250 Mill Street **Rochester, N. Y.**

Shapers *that are* Producers!

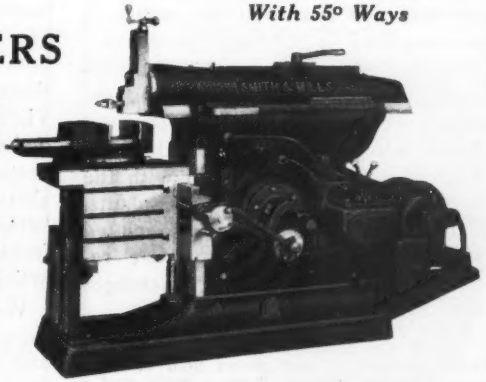
SMITH & MILLS

HIGH SPEED

CRANK SHAPERS

"V"-TYPE RAM

With 55° Ways



Designed for accurate work at high speeds, these machines will be found equally efficient on tool room work or production.

Made in sizes 12" to 32" stroke. 12", 14", 16", 20" and 25" with Gear Box single pulley belt driven or motor drive, also 16", 20" and 25" B. G. cone drive with belt shifter. 32" B. G. all geared single pulley belt drive or motor drive.

Write for Catalog

The SMITH & MILLS CO., Cincinnati, Ohio

MODERN
Machine Shop

Published Monthly at
128 Opera Place, Cincinnati, Ohio
By
DON G. GARDNER - - - *Publisher*
HOWARD CAMPBELL - - - *Editor*

Bigger and Better!

With this issue of MODERN MACHINE SHOP, we call the attention of our readers again to the increase in the number of pages between these covers. This is the second addition of this size within three months, and is a total increase of over 50 per cent in less than a year. We are proud of this wonderful growth, but we realize fully that such growth has only been possible because of the splendid co-operation of our readers. It is no small task to gauge correctly the needs of some 27,000 mechanical executives, and it is a task of no less magnitude to obtain material that will be useful to the executive in the large production plant, the machinery builder, the jobbing shop operator, the tool and die shop executive, and the master mechanic who has charge of the mechanical work in connection with the maintenance of other industrial plants. That our efforts have been appreciated is evidenced by the letters we receive every day, bearing messages such as:

"MODERN MACHINE SHOP is the best little magazine I have gotten hold of yet."
(*Machine shop foreman, a large steel corporation.*)

"The articles by Professor Enos on 'Iron and Steel' are very interesting, as well as the other articles on machine shop practice. Let me add that these articles are well written from the viewpoint of the shop-trained man."
(*Mechanical Engineer.*)

"I receive every copy of your publication that you send to this arsenal, and look forward to the receipt of your instructive and interesting magazine."
(*Shop Supt., U. S. Arsenal.*)

"Your magazine has given me some very good ideas on special machines and appliances."
(*A Chief Tool Designer.*)

"I have just been reading the January edition of MODERN MACHINE SHOP and find it very interesting. It should be beneficial to heads of machine shops."
(*A Shop Owner.*)

"We are sending herewith coupon filled in clipped from your publication. We wish to state that we have found same very useful in the purchase of materials used in the shop."
(*Partner in Job Shop.*)

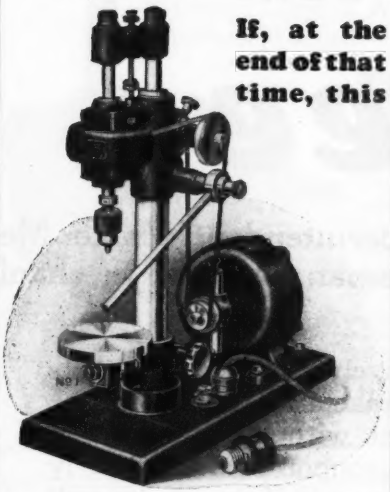
"We have often wondered at what might be called a big waste in paper and printing when we receive several circulars each day and throw them into the WPB, but never a MODERN MACHINE SHOP has gone that way. They are passed along and enjoyed by all."
(*Owner Tool and Die Shop.*)

In addition to these letters of appreciation, every mail brings in requests for information concerning equipment that is either displayed in the advertising pages or mentioned in the editorial section. Each and every one of these requests represents co-operation—and to such co-operation can the steady growth of both the advertising and editorial sections of this magazine be credited. The same sort of co-operation that makes it possible for us to render first-class service to our advertisers also makes it possible for us to give better service to our readers, in the form of more and, perhaps, better articles.

We take this opportunity to thank those who have helped us to build, and herewith renew our pledge, made in our first issue, to give our readers the best editorial material that can be obtained.

Use it for 10 days!

If, at the end of that time, this



"A. M." Sensitive Drilling Machine

has not given entire satisfaction, or has been found inadaptable to the work, it may be returned at our expense.

All we ask is that you send blueprint or sample of work so that we can determine adaptability and size of machine required.

Ask Us For "An Outline of Economical Small Drilling."

Adolph Muehlmatt
Fifth and Elm Sts., S. E.
Cincinnati, Ohio

"HOPKINS" PREFERRED EQUIPMENT

Reduce Costs
Speed Production
Secure Efficiency

Let this "HOPKINS" *Double-Acting* Air Cylinder show you how!

THE ultimate in the economical use of compressed air is now expressed in "HOPKINS" New Series "C" Double-Acting Air Cylinders.

They provide the most satisfactory operation of chucking equipment on chucking machines, punch presses, clamping fixtures, etc., etc.

Every particle of air is put to work by the box pistons. Dead air space is thoroughly eliminated. The total number of packings (automatically sealed by compressed air) have been reduced to 5 in number—eliminating adjustable packing glands. The air-valve and two pipe connections are discarded.

A handle with a connecting rod attached to distributor affords means of operation.

Easily operated because of simple design and construction.

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THE TOMKINS-JOHNSON CO.
620 MECHANIC STREET
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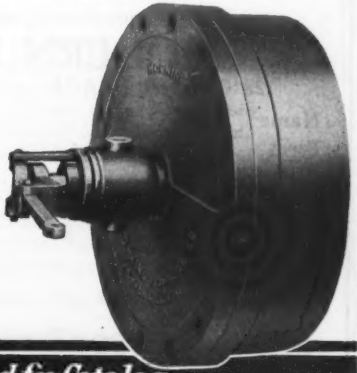
Also Manufacturers of Chucks, Die Sinking Milling Cutters, Work Stands, Special Equipment, Etc.



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MODERN MACHINE SHOP

will be sent

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to any Works Manager, Superintendent, Master Mechanic, Machine Shop Foreman, or other mechanical executive.

Any executive who is actively engaged in supervising the production of machined parts will be placed on our circulation list, without charge, upon receipt by this office of the coupon below, properly filled out. We will be well repaid if the reader will give our advertisers an opportunity to quote prices when he is in the market for equipment—and mention MODERN MACHINE SHOP.

Correct any errors in your name, title, or address, and return to

MODERN MACHINE SHOP
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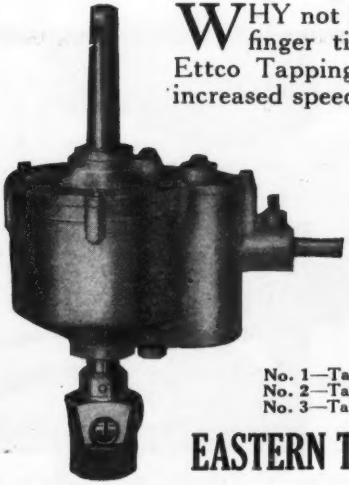
IF YOU TAP HOLES—



WHY not have the feel of the tap right at your finger tips? A tap is a delicate tool. The Ettco Tapping Attachment taps delicately—with increased speed—That's the answer.

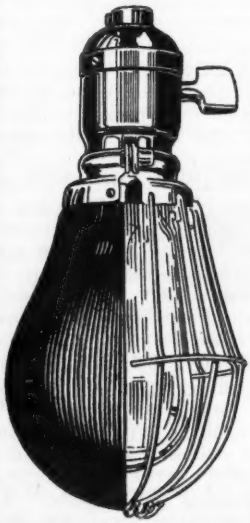
The ETTCO Tapping Attachment

is simple—nothing to adjust—if the tap sticks or hits bottom, the Ettco slips—the same action coming out. No clash of a positive clutch—just the smooth action of the patented leather lined cone clutch.

Sensitive :: Speedy :: Satisfactory

No. 1—Tapping Attachment, 3-16" in steel, ¼" in C. I.....$35.00
No. 2—Tapping Attachment, 5-16" in steel, ⅜" in C. I..... 50.00
No. 3—Tapping Attachment, ½" in steel, ⅝" in C. I..... 80.00

EASTERN TUBE & TOOL CO., Inc. 596 Johnson Ave BROOKLYN, N.Y.



Better Light— Protected Lamps— Greater Production

THE constant glare from unshielded lights that so impairs a worker's efficiency is eliminated with McGill Reflector Guards on the light units. The reflector throws a well directed shaft of light directly on the work and allows the man to do a better and less costly job.

The heavy wire guard protects the lamp from breakage and theft, and cannot be removed without unlocking it with the key that is provided.

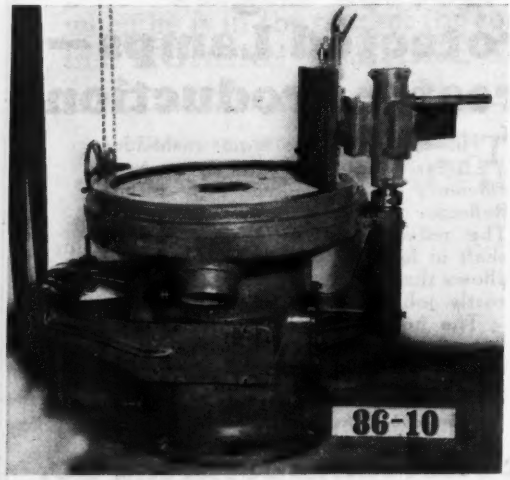
Your Jobber Always Has Them On Hand

McGill Manufacturing Co.
VALPARAISO, INDIANA

New Shop Equipment

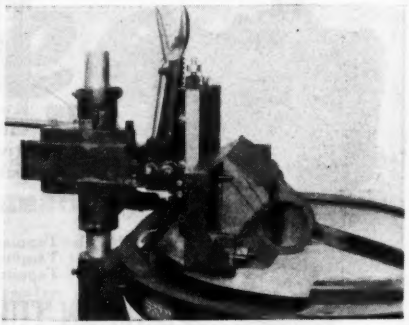
Hand-Operated Swinging Work Table for Gardner 86-30 Hor. Disc Grinder

The use of the hand-operated swinging work table, illustrated herewith, greatly widens the possibilities of the Gardner No. 86-30 Horizontal Disc Grinder, made by the Gardner Machine Co., 428 East Gardner Street, Beloit, Wis. The standard machine of this type, although adapted to the rapid finishing of flat surfaces, simply produces a flat surface which has no relation to any other part of the casting. By using the swinging work table, a piece upon which one surface has been ground can be clamped into a suitable fixture and a second face ground to an accurate definite relation to the first surface.



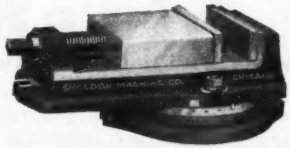
Gardner No. 86-30 Horizontal Disc Grinder equipped with Hand-Operated Swinging Work Table.

The table pivots, as shown in the illustration, on a shaft carried in a bracket that is securely fastened to the machine base. The guard ring of the machine is cut out to the extent required by the size of the parts to be ground, and it is therefore possible to swing the work table across the surface of the disc. Two conveniently-located handles are provided for this purpose. A locking hand lever provides means for raising the table from and lowering it onto the grinding wheel, spring tension providing the necessary pressure against the wheel during the grinding operation. When in grinding position, the work table forms an accurate 90-degree angle with the surface of the wheel. Both longitudinal and vertical adjustment are readily obtainable. The hand-operated swinging work table may be applied to either



Hand-Operated Swinging Work Table in use for grinding crank case covers. Two surfaces are ground square with each other within .005 inch. Production, 25 per hr. complete.

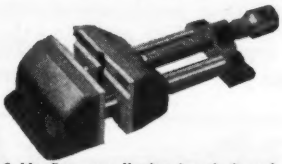
Sheldon Milling Machine Vises



Furnished Both Plain and With Swivel Base.
SPECIFICATIONS AND PRICES:

No.	Width of Jaws	Depth of Jaws	Jaws Open	PLAIN VISE Wt., lbs.	PLAIN VISE Price	SWIVEL VISE Wt., lbs.	SWIVEL VISE Price
3	3½"	1⅜"	2½"	15	$16.00	25	$20.00
4	4½"	1⅝"	3½"	30	$20.00	45	$24.00
6	6½"	2 "	4½"	70	$30.00	90	$40.00
8	8½"	2½"	7 "	160	$45.00	225	$60.00

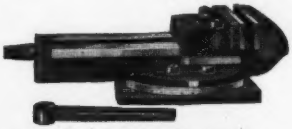
Sheldon Drill Press Vises



Guide Bars are Hardened and Ground.
SPECIFICATIONS AND PRICES:

No.	Width of Jaws	Depth of Jaws over Guide Bars	Full Depth of Jaws	Jaws Open	Wt., lbs.	Price
D 4	4½"	1⅝"	3"	4"	15	$12.00
D 6	6½"	1¾"	3½"	6"	35	$18.00
D 9	9 "	2½"	4½"	9"	70	$24.00

Sheldon Shaper Vises



SPECIFICATIONS AND PRICES:

No.	Size of Jaws	Vise Opens	Bolt Hole Spacing*	Wt., lbs.	Price
1	12" x 2½"	12½"	7½"	175	$120.00
2	14" x 2¾"	13½"	8½"	240	$135.00

*Distance between holes can be changed without additional charge.

Write for Catalog Describing Full Line of SHELDON Tools For the Machine Shop.

SHELDON MACHINE Co.
3251 Cottage Grove Avenue CHICAGO, ILL.

New, Safe, High-speed Quick-As-Wink BUFFING WHEEL

Sizes: 6" and 8" diameter.
Face: 2½" and 3½".
Arbor Sizes: ½" to 2".
Speeds: 3450 to 5000 R. P. M.
Abrasive Strips: 24 to 320 grain.

THIS remarkable buffing system has been adopted by hundreds of factories all over the country for economy, safety and speed. It eliminates all disadvantages of rag-buffs. Perfectly balanced, no chattering. Complete buffing surface brought into action. Tested at 8,000 R. P. M., and thoroughly guaranteed.

Cuts Buffing Costs 50%

A special feature is our patented metal clip which holds the ends of abrasive strips together, permitting their removal and attachment in 30 seconds' time. Quick-As-Wink Wheels make any buffing operation smooth and continuous. No lost time, no waste motion. They speed output, do better work and cut costs in half.

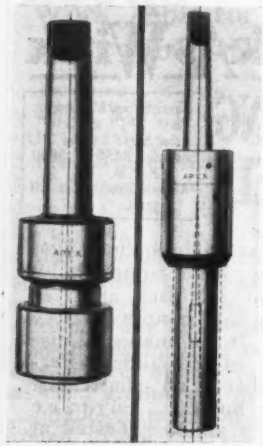
Write for Complete Details

Write immediately for bulletin and prices. If possible, send samples of finished and unfinished work.

C. B. HUNT & SON
639 McKinley Ave., Salem, Ohio

the belt-driven or motor-driven No. 86 grinder.

Apex Floating Tool and Apex Self-Aligning Full Floating Tool Holder



(Left) Apex Self-Aligning Full Floating Tool Holder. (Right) Apex Floating Tool Holder.

The Apex Machine Co., 305 Davis Ave., Dayton, Ohio, has placed on the market two new tools — the floating tool holder and the self-aligning full floating tool holder — shown in the illustration.

The floating tool holder, shown at the right, is a holder which is so designed that it permits the tool to enter the work on a straight line when the machine spindle and the work do not line up although their axis are parallel. The float in this holder is all ball bearing, friction being entirely eliminated. The tool has $\frac{1}{16}$-inch of float, 3/32-inch each side of center. It is furnished with either straight or Morse Taper shank, and with bottom to take straight shank tools, Morse taper shank tools, or with the Apex Quick-Change drill chuck.

The self-aligning full floating tool holder will take care of any angular irregularities between the tool and the work, and will also allow the tool to float parallel to the axis of the rotating part. The floating parts are ball bearing, thus eliminating friction, and the angular alignment is adjustable. This tool is also furnished in several sizes with straight or Morse taper shanks, and with the bottom to hold straight shank tools or tools with Morse taper shanks, or with standard Apex Quick Change drill chucks.

Wells Metal Band Saw

A general purpose metal saw of the hack saw type, but incorporating the advantages of a band saw, has been placed on the market by The Wells Manufacturing Corporation, Three Rivers, Mich. The advantages of the band saw for cutting metal lie in the continuous cutting action of the saw, the smooth operation of the unit in action, and the ability to guide the band so that a smooth surface and an accurate cut will be obtained.

The metal-cutting band is of electrically-welded alloy steel, and is carried on two band wheels, one of which is the driver and the other, the idler. These wheels rotate on double annular bearings and are carried on

Wells Metal Band Saw.

plates so adjusted that if by any chance the saw should become stuck, it will not run off the wheels. Power from the motor is transmitted direct to the driving wheel through simple gearing. The wheels and motor are carried on a rigid frame that will not distort under saw tension when operating at full load. This frame is pivoted on the base and raises for insert-

Now an *Improved*

Rapid Clamp!

Drop-Forged Steel

THE new double-tooth trigger gives the tool added strength and power. Will withstand the hardest usage.

No time wasted turning the screw. Pull the trigger, set the ram up to the work, then give the screw a turn to obtain the necessary pressure. Unequaled for

Speed :: Power :: Rigidity

Made in 6" and 8" sizes. New light 4" clamp ready for delivery soon.

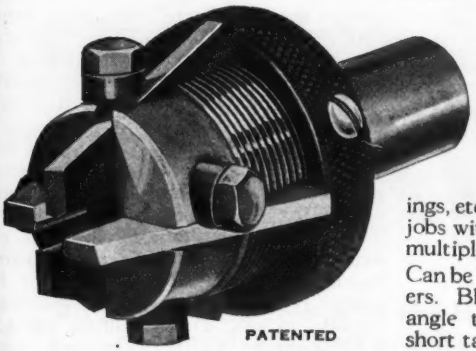
Quality throughout. Every clamp warranted

Fountain Equipment & Mfg. Co.
2025 Elm Street Cincinnati, Ohio

Note the double-tooth trigger

Genesee Adjustable Hollow Mill

Made in 7 different styles



PATENTED

Has adjustable, replaceable blades and can be replaced at nominal cost, making it unnecessary to continually buy new tools.

The ideal tool for finishing your forgings, castings, etc. Do your several operation jobs with Genesee inserted blades multiple operation tools.

Can be fitted with drills and reamers. Blades can be ground any angle to point work and turn short tapers.

A Genesee Adjustable Hollow Mill can be made for every job

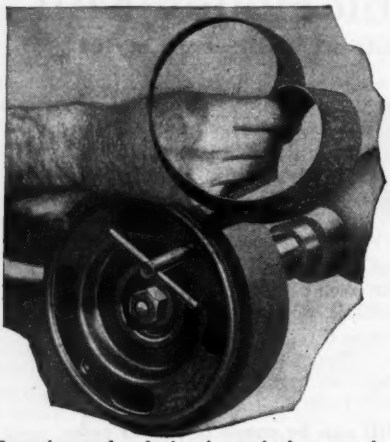
WRITE FOR CATALOGUE

GENESEE MANUFACTURING CO., Inc.
ROCHESTER, NEW YORK

ing the work, lowering when cutting. The saw blade is guided by two rigid posts, each carrying three ball bearings, which hold it true to the work. A variable gravity feed for general cutting is provided by the use of an adjustable weight, and the motor is automatically shut off when the cut is completed. The base of the machine is rugged and well-braced throughout, the legs being arranged so that the machine does not require anchoring to the floor. Capacity, 4-inch round stock. Power feed, adjustable either fast or slow, is provided in addition to the gravity feed. Five saw blades furnished with each machine.. Motor, ⅓ h. p., constant speed, 110 or 220 A. C., 25 or 60 cycles, or 110 D. C. Floor space required, 2 ft. x 4 ft.

"Quick-As-Wink" Buffing Wheel

A buffing wheel which uses abrasive strips that can be removed and replaced within 30 seconds' time has been placed on the market by C. B. Hunt & Son, 639 McKinley Avenue,



Inserting ends of abrasive strip into gap in face of "Quick-As-Wink" buffing wheel.

Salem, Ohio. The strips can be cut to the correct lengths and attached, or they can be secured already bound by a patented metal clip, as shown in the illustrations. The clipped ends of the abrasive strip are inserted into the gap in the rubber face of the wheel and down into a slot. The strip

Locating abrasive cloth in position around buffing wheel. A turn of the wrench locks the cloth in place.

is then folded over the wheel and quickly and tightly locked in place with the use of a special wrench.

The sides of the wheel are heavy gauge steel stampings, pressed onto a heavy circular steel drum. A thick rubber face is cured onto this drum and no degree of speed or heat can cause any of the parts to loosen or break. The attachment of the "Quick-As-Wink" buffing wheel to any stationary or portable spindle is simply a matter of tightening a nut. The entire assembly is accurately balanced so that the wheel runs true and hugs evenly to the object being polished. This buffing system abolishes the expense and delays of reconditioning rag-buffs, as the wheels do not require removal from the machine-spindle to renew the buffing surface. The wearing of threads and other parts, due to removing the rag-buffs from the spindle frequently, are eliminated.

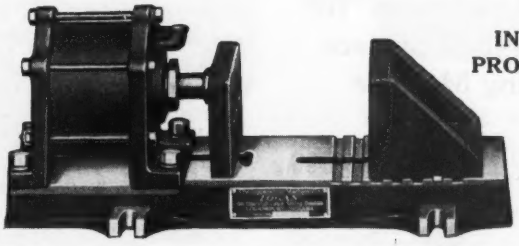
These buffing wheels are manufactured in both 6-inch and 8-inch diameters. Both sizes are made with 2½

Let AIR Do It!

The *"LOGAN"* Model "D" Air-Operated Vise will

SAVE TIME

SAVE LABOR



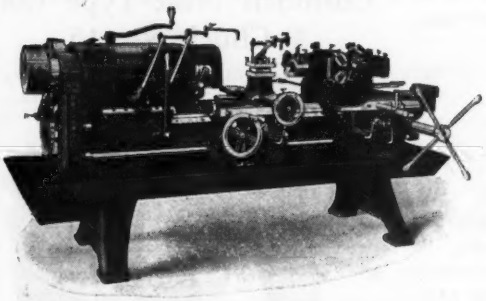
INCREASE PRODUCTION

REDUCE COST

Designed for holding diversified forms of work in various lengths by the use of false jaws, for assembling or drilling operations. This is one of a complete line of Air-Operated Work-Holding Devices described in our Catalog R-23. Free to any mechanical executive!

LOGANSPORT MACHINE CO. Logansport, Ind.

CINCINNATI ACME No. 1 and No. 2 Semi and Full Universal Turret Lathes have Spindles that are Equipped with Anti-Friction Bearings.



All of the Gear Shafts in the Headstock and Aprons Revolve in Ball and Roller Bearings.

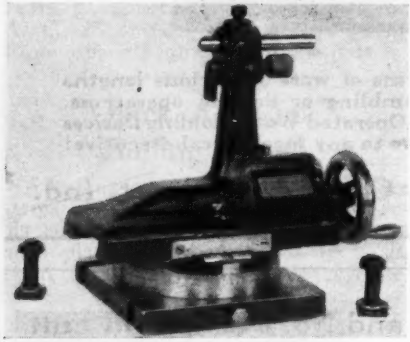
WRITE FOR DESCRIPTIVE BULLETIN.

THE ACME MACHINE TOOL CO.
CINCINNATI, OHIO

inch and 3½ inch faces and with arbors of ½ inch to 2 inch diameters. Abrasive strips of from 24 to 320 grain can be applied.

Radius and Angular Wheel-Truing Attachment for B. & S. No. 2 Surface Grinding Machine

The Brown & Sharpe Mfg. Co., of Providence, R. I., has announced a new radius and angular wheel-truing



B. & S. Radius and Angular Wheel-Truing Attachment.

attachment for its No. 2 surface grinding machine.

The attachment is designed to provide an accurate and efficient means of shaping abrasive wheels used on the surface grinding machine. It is particularly desirable when grinding such work as lamination dies, flat forming tools, and miscellaneous pieces requiring wheels having radial or angular faces.

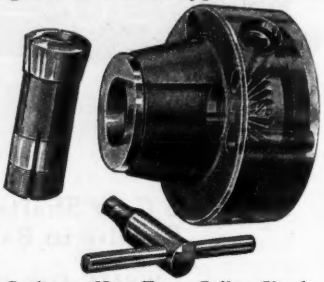
The attachment consists of a base of cast iron, graduated to 90 degrees either side of zero and carrying a swivel platen. A slide that can be adjusted longitudinally by a handwheel to 64ths of an inch either side of zero is mounted on this platen. A Gib and Adjusting Screws afford means of compensation for wear. An upright, integral with the slide, holds the diamond tool and diamond tool-attachment, outlines having concave or convex radii carrying from 0 to 1 inch, and face angles up to 90 degrees either side of zero, can be formed. Numerous combinations of radial and angular shapes otherwise difficult to obtain can be easily developed.

Convex and concave shapes are obtained by setting the slide, by means of the scale, to the desired radius, and clamping it in position. The diamond point is set by the diamond tool setting gauge. The diamond is then swivelled through an arc sufficient to develop the radius upon the wheel. Angular faces are formed by clamping the swivel at the required angle and operating the slide by means of the handwheel. The diamond tool is held in the upright post at right angles to the slide.

Clamping bolts and nuts are provided for bolting the attachment to the machine table.

Cushman Nose-Type Collet Chuck No. 15

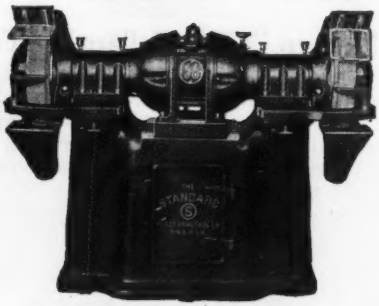
The Cushman Chuck Company, 805 Windsor Street, Hartford, Conn., has brought out a nose-type collet chuck



Cushman Nose-Type Collet Chuck.

that has been especially designed so that collets can be used in larger sizes than has been the case heretofore. With this chuck, any bar can

Standard Ball Bearing Electric Drills, Grinders, Polishers and Buffers



HEAVY DUTY GRINDER

G. E. 40 Degree Motor and Push Button Control. Four S. K. F. Ball Bearings. Nickel Steel Armature Shaft. Made in 5, 7½ and 10 H. P. sizes.

GENERAL ELECTRIC UNIVERSAL MOTOR DRILLS

G. E. Universal Motor, S. K. F. Ball Bearings. Gears made out of chrome-nickel steel and run in grease. Trigger switch. Made in ¼", 5/16", ⅜", ½", ⅝", ¾", 1" and 1¼" capacity in steel.

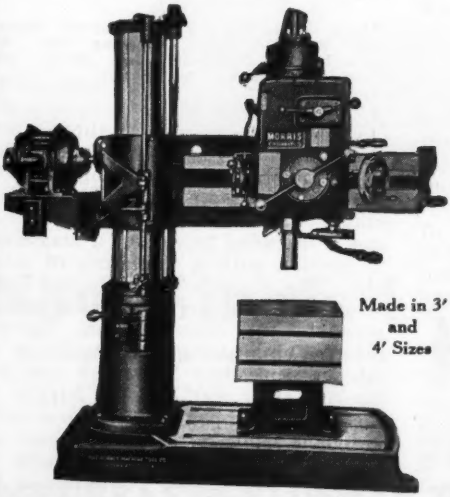
Write for Late Catalog

THE STANDARD ELECTRICAL TOOL CO.

ESTABLISHED 1912 **CINCINNATI, OHIO**

INCREASED SPEED

- - - *Less Power Used*



Made in 3' and 4' Sizes

Levers, conveniently located on the head, allow instant change of feed and speed. Index plates in front of head tell combinations. There's no hunting for changes with *Morris Mor-Speed Radials.* With Timkin Roller Bearing construction speed is increased, less power is used.

Morris Mor-Speeds enable men to do more in less time with less fatigue. Many other advanced features are explained in our Mor-speed Bulletin. Send for it.

MORRIS MACHINE TOOL CO.

Court and Harriet Sts., Cincinnati, O.

Note simplicity and Convenience of Control

be held that will pass through the lathe spindle, if it is not over 1¾ inches in diameter. The chuck offers no obstruction to the hole and is mounted on the spindle nose by bolting it to an intermediate plate in the same manner as the usual lathe chuck. The body of the chuck is a solid piece of heat-treated steel, which, after hardening, has been ground perfectly true on both its outer and inner surfaces. As there are two ground bearings for the collet, one at the back of the body and the other at the nose, it is possible to hold work very accurately. A fine grade of alloy steel is used for the discs and pinions, which are heat-treated. When chucking work in the No. 15, the operator approaches the machine in the usual way, and it is not necessary to hold the lathe spindle to keep it from turning when using the wrench.

Parker-Kalon "Screwnail"

A nail which combines the qualities of both a nail and a screw, and which, when used for fastening sheet metal to wood, will neither bend, back out, nor loosen as do ordinary nails, has been developed by the Parker-Kalon Corporation, 192-196 Varick St., New York, N. Y. The nail is called the "screwnail," because it is driven like a nail and holds like a screw.

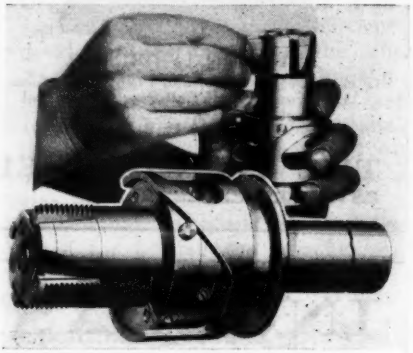
The hardened spiral thread and needle-pointed pilot of the screwnail enable it to be driven through much heavier sheet metal than ordinary nails can be driven through without bending, and, in many cases, eliminates the necessity of punching or drilling holes in sheet metal. The hardened spiral thread of the screwnail forms a thread in the metal and

Parker-Kalon "Screwnail."

wood, securely fastening the metal to the wood. Laboratory tests made at Columbia University show that hardened screwnails have more than four times the holding power of ordinary nails. The screwnail is particularly adapted for fastening body, door and roof, trim pads, upholstery, drip and running board mouldings, and so on.

Namco "CR" Collapsing Tap

The National Acme Company, East 131st Street, Cleveland, Ohio, has brought out a collapsing tap that is especially designed to save most of the time that is lost in exchanging dull chasers for sharp ones. To release the chasers it is only necessary to loosen one screw, after which they

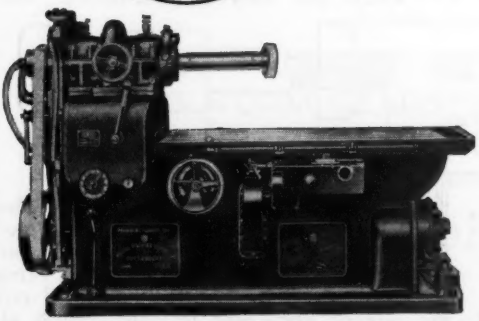


(Above)—Inserting a set of chasers in Namco "CR" Revolving Type Collapsing Tap. (Below)—Namco Collapsing Tap, shown with chasers "set" to cut.

can be removed with the thumb and finger. New chasers are slipped into place in the same manner, the tightening of the screw serving to lock the chasers in position. The tool is simple of design and construction, and is intended to render a maximum of service with a minimum of trouble. The chasers are collapsed by a positive cam action mechanism which prevents the chasers from tipping, thereby eliminating the possibility of tapered threads. No chips nor dirt can find their way into the interior of the tool, the open construction making it possible to clean the tool instantly by blowing air through it. Positive adjustment is obtained by two opposed screws which are self-

GRINDERS Micro

A Better Method of Internal Grinding



THE ability of MICRO Internal Grinders to deliver highly satisfactory results has been the impelling force that has brought about MICRO installations in many of the largest and most progressive industrial machine shops.

The unanimous verdict of these many users is that MICRO provides a *faster, better, cheaper* method of internal grinding.

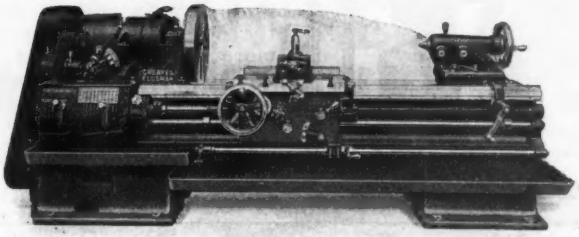
Write for the complete MICRO story

MICRO MACHINE COMPANY

Bettendorf — MANUFACTURERS AND DESIGNERS OF *PRECISION GRINDERS* FOR ALL PURPOSES — Iowa, U-S-A

SAVE OPERATING MINUTES AND LOWER COSTS

Flexible Motor Drive



Single Lever Control

New Single Lever Control

Production costs are gauged by machining time. By saving operating minutes you lower costs. Operating time is the big factor in G-K Single Lever Control Heavy Duty Lathes.

Any one of a wide range of spindle speeds can be obtained through a single lever—instantly—thus enabling any lathe operator to easily hold to set production schedules.

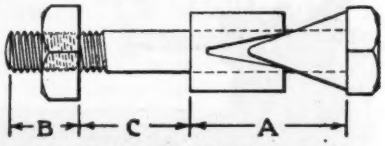
The other production-precision features of G-K Single Lever Control Heavy Duty Lathes are detailed in the Catalog, a copy of which comes for the asking.

THE GREAVES-KLUSMAN TOOL CO., Cincinnati, O.

locking. The parts of this tap are hardened and ground throughout, and every tool is carefully inspected for perfection of workmanship and operation before being released for the market.

"E-Z" Bolt Anchor

An important saving in time and labor can now be made on the installation of machinery, railings, motors, or other units that require anchoring in place, by the use of the "E-Z" bolt anchor, made by The Kempton Manufacturing Corporation, 148 West 23rd St., New York City. The unit consists of a lead expansion member and an iron wedge member, which are used with whatever size bolt the equipment requires. The cross-section drawing shows the two members assembled with a bolt and nut, the length of bolt required being determined by (A) the length of one anchor unit, plus (B) the length allowed for the nut, plus (C) the thickness of the part that is to be anchored. The anchors can be used with any machine bolt.

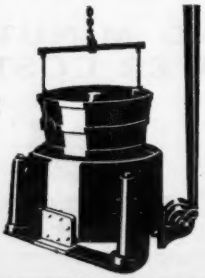


Cross-Section of "E-Z" Bolt Anchor.

To install, the bolt is inserted head first in the hole, then the iron wedge member is slipped over the end of the bolt and into the hole, followed by the expansion member. As the nut is screwed down and pull is exerted on the bolt, the iron wedge expands the lead member against the surface of the hole. The greater the pull, the more the anchor grips the wall of the hole. The unit is guaranteed by the manufacturers to hold beyond the tensile and shearing strength of any wrought iron bolt. The anchor can be furnished for any size of bolt from ¼-inch diameter up.

The Tolhurst Chip Wringer Saves Cutting Oil

The Tolhurst Chip Wringer saves dollars in cutting oil by reclaiming the oil for use over and over again. Reclaims 6 to 15 gallons per load, 4 or more loads per hour. Basket size 20" to 48". Capacities 1 to 10 bushels.



Write for Catalog

TOLHURST MACHINE WORKS, Inc.
TROY, N. Y.

New York Office
183 Madison Av.

Chicago Office
8 S. Dearborn St.

GRINDING WHEEL DRESSERS

THE DESMOND DIAMO-CARBO DRESSER

The best all-around Tool Room Dresser. The steel tube is filled with an extremely hard abrasive which is very durable and economical.

Write For Catalog M

The DESMOND-STEPHAN MFG. CO., Urbana, O.

The Steel Products Engineering Co.

SPRINGFIELD, OHIO

MANUFACTURERS OF SPUR, SPIRAL, BEVEL AND WORM GEARS, CUT TO CLOSE TOLERANCES

CONTRACT AND PRODUCTION WORK

Designers and Builders of Special Machinery

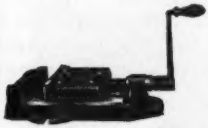
Averbeck Shapers ***Brehm Trimming Dies***

The **DURABILITY** *and* **RELIABILITY** *of the*

SKINNER

MILLING MACHINE VISE

CRANK HANDLE TYPE



FLANGED VISE

SWIVEL BASE

HAVE BEEN PROVED THROUGH MANY YEARS OF SERVICE

THE many years of satisfactory service have proved these to be durable and reliable.

Both jaws are steel lined, and the movable jaw is controlled by a large screw with a drop forged steel, hardened crank handle, the thrust being taken by heavy collars.

Size No.	List Price Flanged	Size No.	Swivel	Width of Jaws	Depth of Jaws	Opening
4-F	$30.00	.....	.....	4⅛"	1 1/16"	2"
5-F	33.00	5-FS	$48.00	5⅛"	1 7/16"	3 5/16"
6-F	51.00	6-FS	60.00	6⅛"	1⅝"	3 7/8"
7-F	74.00	7-FS	84.00	7¼"	1 13/16"	4 7/16"
8-F	105.00	8-FS	120.00	8¾"	1 15/16"	6 7/16"

The body is of extra heavy certified malleable iron and arranged with four U-shaped lugs for clamping, each pair permitting clamping at right angles to the other.

SKINNER CHUCKS

The Skinner Chuck Company

NEW BRITAIN, CONN., U. S. A.

Multiple Units

From Single Drills

Designed to fit any type of drill press, a U. S. Drill Head converts any single spindle drill into a multiple unit quickly.

No time wasted making adjustments—spindles are fixed. Any number of holes, fifty if necessary, can be drilled as easily as one.

We will design a U. S. Multiple Drill Head to meet your individual requirements. Tell us your needs. Address

The United States Drill Head Co.

1954 Riverside Drive

Cincinnati, O., U. S. A.

Portable Brass Melting Furnace

(*Continued from page 64*)

ing brass on the hubs or face of the driving box has become common, therefore the furnace described here will be found very useful.

The drawing shows the dimensions for the various parts. The furnace is mounted on two wheels so that it can be moved about. A shop that is reconditioning twenty-five or thirty engines per month may have as many as from 200 to 300 driving boxes for which new hubs will have to be poured, in addition to other castings that may be needed, such as brass crosshead shoes or driving box shoes and wedges. The furnace can be built at a minimum cost, and the jets for burning crude or coal oil can be easily obtained from manufacturers who specialize in this type of equipment.

Simple Tool Steel Test

(*Continued from page 58*)

cooler than nearer to the top surface.

It will be noted that the case is deeper at the corners than elsewhere, indicating that external corners cool more rapidly than other surfaces, due to the fact that the heat is dissipated from adjacent sides toward the center. It is for this reason that external corners sometimes crack in the quenching bath; the corners have cooled and set while the core is still in a semi-plastic state.

GEARS

All Kinds—Small—In Stock

The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.

Write for Catalog 80

CHICAGO STOCK GEAR WORKS

105-9 S. Jefferson St. Chicago, Ill.

PROCUNIER

SAFETY TAPPING ATTACHMENT with the "Procunier" Safety Friction and "Double-Jaw" tap holder gives

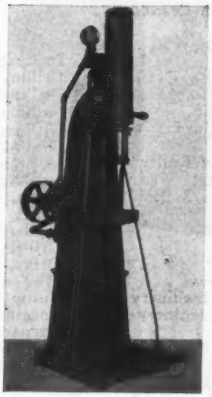
GREATER ACCURACY and LESS TAP BREAKAGE

The Procunier Safety Friction Device is very easily adjusted. With it blind holes can be tapped just as easily as through holes, and without danger of breakage.

Catalogue 102-C gives complete details of PROCUNIER Tapping Devices, Quick Change Chucks, Stud Setting Tools and Bench Tapping Machines.

PROCUNIER SAFETY CHUCK CO.
12 So. Clinton St. Chicago, Ill.

BROACH *for Accuracy—Economy!*

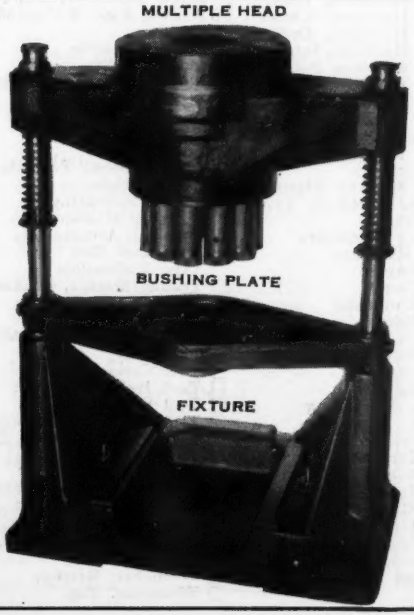


Let us show you how to finish more holes—more accurately—and at less cost.

The American 2-Ton Hydraulic Press

is recommended for broaching connecting rods and work that comes within the 2-ton range. We manufacture presses from 2 tons to 150 tons pressure, also all types of broaching tools.

AMERICAN BROACH & MACHINE CO.
ANN ARBOR, MICHIGAN



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STANDARDIZED
Multiple Head, Bushing Plate and Fixture } held in positive and perfect alignment for
Drilling, Reaming, Boring, Tapping

OUR SKILLED TOOL ENGINEERS
Will be pleased to furnish complete data and submit quotations on the equipment best suited to your purpose.

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Check For Information Wanted

If you are interested in prices or information on any of the equipment listed, check the item, write your name, firm name, title and address on the margin, tear out the page and send it to Modern Machine Shop, 128 Opera Place, Cincinnati, Ohio. We will see that you are supplied with the information desired.

- ☐ Abrasive Discs
- ☐ Abrasive Polishing Grains
- ☐ Arbors
- ☐ Babbitt Metal
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- ☐ Balancing Ways
- ☐ Bearings, Ball or Roller
- ☐ Bearings, Die-cast
- ☐ Bearings, Bronze & Bab't
- ☐ Belting, Leather
- ☐ Belt Dressing
- ☐ Bench Legs
- ☐ Benches
- ☐ Bending Machines
- ☐ Blue Printing Machinery
- ☐ Bolt and Nut Machinery
- ☐ Bolts and Nuts
- ☐ Bolts, Stripper
- ☐ Boring Bars
- ☐ Boring Mills, Vertical
- ☐ Boring Mills, Horizontal
- ☐ Boring Heads
- ☐ Boring Tools
- ☐ Broaches
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- ☐ Chucks, Drill and Tap
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- ☐ Countersinks
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- ☐ Cutters, Gear
- ☐ Cutters, Keyseating
- ☐ Cutters, Milling
- ☐ Cutting-Off Machines
- ☐ Cutting-Off Tools
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- ☐ Dies, Threading
- ☐ Die Sets
- ☐ Die Shoes
- ☐ Dividing Heads
- ☐ Dogs, Lathe
- ☐ Dowel Pins
- ☐ Dressers, Grinding Wheel
- ☐ Drill Holders
- ☐ Drilling Machines, Bench
- ☐ Drilling Machines, Sensitive
- ☐ Drilling Machine Heads
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- ☐ Drilling Machines, Multiple
- ☐ Drilling Machines, Radial
- ☐ Drills, Center
- ☐ Drills, Portable Electric
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- ☐ Drills, Ratchet
- ☐ Drills, Twist and Flat
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- ☐ Furniture, Machine Shop
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- ☐ Gauges, Dial
- ☐ Gauges, Plug and Ring
- ☐ Gauges, Thread
- ☐ Gear Blanks, Composition
- ☐ Gear-Cutting Machinery
- ☐ Gears, Cast or Cut
- ☐ Grinding Mach., Cylindrical
- ☐ Grinding Machines, Univ.
- ☐ Grinding Machines, Cutter
- ☐ Grinding Machines, Drill
- ☐ Grinding Machines, Internal
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- ☐ Grinding Machines, Surface
- ☐ Grinding Wheels
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- ☐ Hammers, Pneumatic
- ☐ Hobbing Machines
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- ☐ Hoists, Chain or Electric
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- ☐ Lathe Dogs
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- ☐ Pumps, Lubricant or Oil
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- ☐ Punches, Power
- ☐ Punch Holders
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- ☐ Reamer Holders
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- ☐ Riveting Machines
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- ☐ Scales, Machinists'
- ☐ Screw Machines, Automatic
- ☐ Screw Machines, Hand
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- ☐ Shafts, Flexible
- ☐ Shapers
- ☐ Shears, Hand or Power
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- ☐ Springs, Pressure Pad
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- ☐ Stands, Shop, Portable
- ☐ Tap Holders
- ☐ Tapes, Measuring
- ☐ Tapping Machines
- ☐ Tapping Attachments
- ☐ Taps and Dies
- ☐ Taps, Collapsible
- ☐ Testing Mach'y, Hardness
- ☐ Thread-Cutting Tools
- ☐ Threading Machines
- ☐ Thread Mill. & Roll. Mach'y
- ☐ Tool Bits
- ☐ Tool Cases
- ☐ Tool Holders
- ☐ Tool Posts, Lathe
- ☐ Trolleys and Tramways
- ☐ Trucks, Hand, Lift, Power
- ☐ Turrets, Tool Post
- ☐ Valves, Air Control
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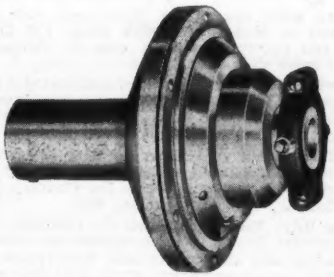
- ☐ Welding Equip. & Supplies
- ☐ Welding Machines, Electric
- ☐ Wrenches, Drop-Forged
- ☐ Wrenches, Pipe
- ☐ Wrenches, Ratchet
- ☐ Wrenches, Tap



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Husky — simple — attractive — entirely enclosed — balanced — and immune to centrifugal force at any speed.

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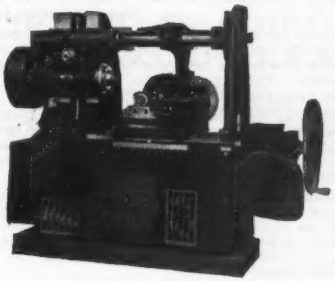

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3 SIZES of Hobbing Machines... all of them capable of making spur and spiral gears, sprockets, ratchets and splined shafts... "universal" type... excellent equipment for the up-to-date manufacturer or machine shop ... Send for our circulars.

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For Your Catalog Library

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Turret Lathes and Tools: Illustrated book describing Cincinnati Acme Turret Lathes and Screw Machines, and showing a variety of tools and fixtures for use with these machines. The Acme Machine Tool Co., 4955 Spring Grove Ave., Cincinnati, Ohio.

Broaching By Modern Methods: Equipment and tools for finishing round, square or irregular-shaped holes and surfaces by broaching are described and illustrated in a booklet that is issued free by the American Broach & Machine Co., Ann Arbor, Michigan.

Scraping By Power: Bearing surfaces can now be scraped with a power scraper that is quicker and easier than the old-fashioned hand method. The tool is described in a folder that is issued by Anderson Bros. Mfg. Co., 1926 Kishwaukee St., Rockford, Ill. Sent free on request.

Steel Furniture for the Shop: The complete line of steel furniture made by the Angle Steel Stool Co., Plainwell, Michigan, including steel stools and chairs, steel foremen's desks, lockers, tables, tool stands, machine tenders, shop boxes and pans, iron bar racks, trucks, bench legs, and bench drawers, is described and illustrated in Catalog "C," which is issued free to machine shop executives.

Stop Tap Breakage: A booklet that tells how to stop the breakage of taps, reamers, and other tools, by the use of a friction chuck, also how to use the chuck for setting studs or nuts, has been issued by The Apex Machine Co., 200 Davis Ave., Dayton, Ohio. Sent free upon request.

Machine Shop Accessories: Catalog B-27, issued by the Armstrong Bros. Tool Co., 328 N. Francisco Ave., Chicago, Ill., describes the line of tool holders, boring tools, wrenches, pipe tools, ratchet drills, lathe dogs, and other tools manufactured by this company.

Hobs and Milling Cutters: A complete line of milling cutters and hobs for cutting all kinds of gears, splines, sprockets and other forms is described in Catalog G, issued by the Barber-Colman Company, Rockford, Ill. Descriptions and illustrations of the Barber-Colman hobbing machine and hob-sharpening machines are included. Sent free on request.

All-Geared Drilling and Tapping Machines: A catalog describing in detail the various types of all-geared, self-oiling, drilling and tapping machines made by the Barnes Drill Co., 801-851 Chestnut Street, Rockford, Ill., will be sent free upon request.

Modern Drilling Equipment: Circulars describing the various types and sizes of Barnes upright drills, multiple drills and horizontal drilling machines made by this company have been issued by the W. F. & John Barnes Co., Rockford, Ill.

Automatic Oiled Die Sets: The automatic oiled die sets, die shoes, punch holders, leader pins, bolster plates, bushings, and other standard die parts made by the E. A. Baumbach Manfg. Co., 1806 S. Kilbourn Ave., Chicago, Ill., are described in Catalog No. 5, which has been issued by that company. Sent free upon request.

Bradford Precision Lathes: Precision Lathes for the tool room and for general manufacturing purposes, all-geared and cone types, belt or motor driven, are described and illustrated in a catalog that is issued by The Bradford Machine Tool Co., 657-671 Evans St., Cincinnati, Ohio. The catalog also includes descriptions of taper, relieving, turret and other lathe attachments. Sent free upon request.

How to Sharpen Cutters: A series of leaflets, which describe and illustrate the correct methods to employ in sharpening all kinds of cutters, can be obtained, without charge, by addressing Brown & Sharpe Mfg. Co., Providence, R. I.

Gears of All Kinds are described and illustrated, with specifications, in Catalog 80 which has been issued by the Chicago Stock Gear Works, 105-9 S. Jefferson St., Chicago, Ill. Copy sent free on request.

Drilling Machinery: Circulars describing all types and sizes of radials, uprights, and gang drills for every class of work may be had by writing to The Cincinnati Bickford Tool Co., Oakwood, Cincinnati, Ohio.

Gear Data: The Cincinnati Gear Co., Cincinnati, Ohio, has published Catalog D, which describes and illustrates the various types and kinds of gears made by this firm. The book contains photographs of the plant departments, with descriptions of the equipment employed, and also includes a number of pages of valuable data and reference tables for machine shop use.

Rapid Traverse Planers: Cincinnati Hypro Planers, made by the Cincinnati Planer Co., Cincinnati, Ohio, are described in a new catalog that has been issued by this company.

Shaper Progress: An illustrated catalog describing the various types of shapers made by the Cincinnati Shaper Co., Cincinnati, Ohio, and including descriptions of Cincinnati Shapers in use in different kinds of plants.

Cisco Engine and Tool Room Lathes, manufactured by the Cisco Machine Tool Co., 1765-69 Elmore St., Cincinnati, Ohio, are fully described in their catalog. This catalog also includes descriptions of their Radial Drill, Tapping Machine, and Special Attachments.

Handbook For Drillers: The Cleveland Twist Drill Co., 1242 E. Forty-ninth St., Cleveland, Ohio, has published a book in which the various parts of the twist drill are described, and which tells how to grind a drill correctly. The troubles that result from incorrect grinding are described and illustrated and several chapters are devoted to the subjects of speeds, feeds, materials, cutting compounds, and so on. Sent free upon request.

Inserted Blade Reamers: A new type of reamer with high speed steel blades, designed to reduce cutting costs and give longer service, is described in a bulletin that will be sent without charge upon application to the Conradson Tool Corporation, 2114 Indiana Ave., Chicago, Ill.

Disc, Expansion and Compression Clutches: The various types of clutches and their uses are discussed in an illustrated booklet that is issued by The Conway Clutch Co., 1959 West Sixth Street, Cincinnati, Ohio.

Cushman Chucks: A series of bulletins has been issued by The Cushman Chuck Co., 805 Windsor St., Hartford, Conn., describing the lathe, screw machine, boring mill, drill press and other chucks made by this firm. Sent free upon request.

Die Makers' Supplies: A complete line of die sets, leader pins, bushings, and other die makers' supplies are described in a book that is issued by the Danly Machine Specialties, Inc., 2104 South 52nd Avenue, Chicago, Ill. Sent free upon request.

Davis Keyseaters: Recent developments in keyseating methods are discussed in a bulletin that also describes the keyseaters made by the Davis Keyseater Company, 250 Mill St., Rochester, N. Y. Copy free upon request.

Grinding Wheel Dressers: All of the different types of grinding wheel dressers made by the Desmond-Stephan Mfg. Co., Urbana, Ohio, including Desmond-Huntington, Desmond-Sherman, Zig-Zag, Diamo-Carbo, and diamond dressers, are described and illustrated in a catalog that has been published by the firm mentioned. Free upon request.

"Lectrospray" Paint Spraying Gun

A paint spraying outfit that is complete with a gun and a motor compressor unit which may be suspended from the shoulder by means of a strap, has been placed on the market by the Weil Electrospray Company, Detroit, Mich. This outfit makes it possible to spray paint any place where electrical connection can be obtained, and is entirely independent of any other air supply. The spray gun is of convenient design and is supplied with adjustable nozzle and shut off button which makes it possible to regulate the density of the spray from a light mist to as heavy an application as may be desired.

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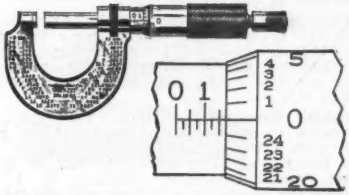

Illustration shows new method of marking the sleeve; every thousandth numbered. It makes reading quicker, easier, and more positive.

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THE LUFKIN RULE CO.
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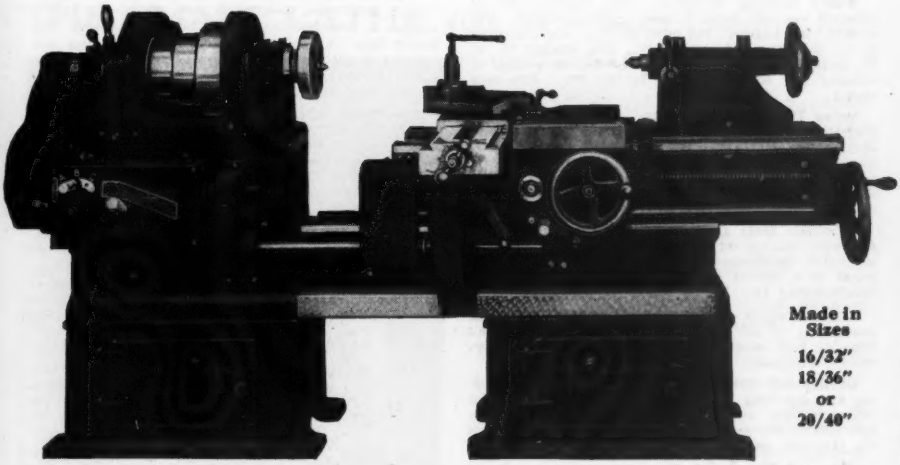

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A lathe for large or small swing work, ready at all times. Requires no extra rigging up. Takes different distances between centers.

Belt driven or with nine speed all geared motor driven head. Tell us what your requirements are and let us quote you.

THE RAHN-LARMON CO. 2935 Spring Grove Ave., Cincinnati, Ohio

Quantity Drilling: A semi-automatic multiple spindle drilling machine which is designed to produce the maximum of drilled holes in medium or small parts, is described in a pamphlet that is published by the Detroit Machine Tool Co., 5055 Woodward Ave., Detroit, Michigan. Sent free upon request.

High Speed Tapping Methods are described in a booklet that is issued by the Eastern Tube & Tool Co., 596 Johnson Ave., Brooklyn, N. Y. The booklet also describes in detail the tapping machines and attachments made by this company.

Interchangeable High Production Tools: Catalog No. 28, issued free by the Eclipse Interchangeable Counterbore Co., 7410 St. Aubin St., Detroit, Michigan, describes and illustrates the interchangeable counterbores, spot facers, end form cutters, and other end cutting tools made by this firm.

Precision Measuring Instruments: The latest types and models of dial indicators, thread lead test gages, pitch gages, thickness gages, dial comparators, and other precision measuring instruments marketed by the Federal Products Corporation, Providence, R. I., are described and illustrated in a book that will be sent free upon application to this firm.

Formica Silent Composition Gears: A booklet telling about the uses and advantages of Formica Silent Shock Absorbing Gears, and containing a considerable amount of valuable data with rules and tables for laying out, cutting and using gears. Sent free by Formica Insulation Co., 4632 Spring Grove Avenue, Cincinnati, Ohio.

Fosdick Drills: This publication gives details as to the design and construction of Fosdick Radial, Upright, and Sensitive Drills. Published by the Fosdick Machine Tool Co., Cincinnati, Ohio.

Quick-Acting Clamp: A bulletin describing the "Rapid" drop-forged steel clamp manufactured by the Fountain Equipment & Mfg. Co., 2025 Elm St., Cincinnati, Ohio, has been issued by this firm.

Modern Grinding Equipment: The complete line of universal tool and cutter grinders, surface grinders, drill grinders, tap grinders, and other grinding machines made by the Gallmeyer & Livingston Co., 336 Straight St., S. W., Grand Rapids, Michigan, is described in a series of bulletins that have been issued by this firm. Free upon request.

Saving Time by Disc Grinding: A book that tells how production costs can be reduced by the use of modern disc-grinding equipment, and which describes and illustrates the latest types of machines used for this work, has been issued by the Gardner Machine Company, Beloit, Wis. A number of illustrations of jobs in operation, together with complete production data, are included.

Adjustable Blade Cutters: Hollow mills, facing tools, face mills, milling cutters and other production tools with adjustable, interchangeable blades are described and illustrated in a booklet that is issued free by the Genesee Manufacturing Co., 141 N. Water St., Rochester, N. Y.

Greaves-Klusman Lathes: A book containing complete descriptions of the latest types of lathes made by this firm has been issued by the Greaves-Klusman Tool Co., Oakley, Cincinnati, Ohio.

Drilling and Grinding Electrically: Catalog M, showing and describing a variety of modern electric portable drills, grinders, and other tools, including floor grinders and buffers, has been issued by The Hisey-Wolf Machine Co., Colerain and Marshall Sts., Cincinnati, Ohio.

Vises and Pipe Tools: The bench, machine and pipe vises, pipe cutting and threading tools, babbitt ladles and melting pots made by the Hollands Manufacturing Co., 344 E. 18th St., Erie, Pa., are described and illustrated in a booklet that is issued free by the firm mentioned.

"Quick-As-Wink" Buffing Wheels that eliminate all disadvantages of rag-buffs, speed output, do better work, and cut buffing costs to the minimum are described in a bulletin that is issued free by C. B. Hunt & Son, 639 McKinley Ave., Salem, Ohio.

Internal Grinding Equipment: The latest equipment for grinding holes of all sizes, from small wrist pin holes to the holes in locomotive cylinders, is described and illustrated in a booklet that will be sent free by the Hutto Engineering Co., Inc., 542 Lacaste Ave., Detroit, Michigan.

Assembling with Electricity: Light, portable electric tools for drilling, tapping holes, and for driving screws are described in a booklet which can be had without cost by addressing the Independent Pneumatic Tool Co., 236 South Jefferson Street, Chicago, Ill.

Special Mil-Waukee-Mils of Standard Units: A milling machine of which the base, heads, columns, and other parts are built in standard units, thus enabling the user to order a machine that will be especially adapted for his job, is described and illustrated in Catalog No. 36, issued by the Kearney & Trecker Corporation, Milwaukee, Wis. Free to machine shop executives.

Standardized Jigs and Fixtures: Information concerning standardized jigs and fixtures, also all kinds of special equipment for production, can be had by writing to H. R. Krueger & Co., 439 East Fort St., Detroit, Mich.

Cutter and Tool Grinding: A book that tells how to grind tools and cutters accurately and which also describes and illustrates the different types of LeBlond Universal Tool Room Grinders will be sent free upon request. Address, The R. K. LeBlond Machine Tool Co., Cincinnati, Ohio.

Lehmann Lathes: Details of the outstanding features of Lehmann Lathes are given in a catalog published by the Lehmann Machine Co., 3560 Chouteau Ave., St. Louis.

Air-Operated Work-Holding Devices: A booklet showing how air-operated chucks and devices of various kinds can be applied to different kinds of machines to save time and labor has been issued by The Logansport Machine Co., Logansport, Ind.

Rapid-Reading Micrometer: A new type of rapid-reading micrometer, designed to show the reading in numerals, is described in Catalog No. 5, issued by The Lufkin Rule Co., Saginaw, Michigan. The catalog also contains descriptions of the micrometers, calipers, gauges, scales, squares, bevel protractors, and other tools made by this company. Free upon request.

Time Saving Machine Equipment: How machining time can be reduced to the minimum by the use of Wizard chucks, collets and tap holders, turret tool posts, self-centering steadyrests, and other McCrosky equipment is told in a book that is issued by the McCrosky Tool Corporation, Meadville, Penna. Will be sent without charge.

Lamp Guards: The various types and kinds of lamp guards made by the McGill Manufacturing Co., Valparaiso, Ind., for factory use are described in a catalog that will be sent free upon request.

Accuracy in Internal Grinding: The latest methods of producing accurately-ground holes are described in a booklet which also describes and illustrates the internal grinders made by the Micro Machine Co., Bettendorf, Iowa. Sent free upon request.

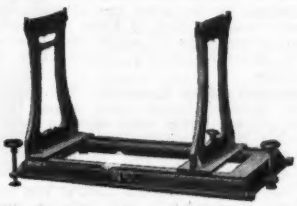
Roller Bearing Radial Drills: The application of Timken roller bearings in the design of modern radial drilling machines is discussed in a bulletin describing "Mor"-Speed Radial Drills, published by the Morris Machine Tool Co., Cincinnati, Ohio.

An Outline of Economical Small Drilling: The subject of small-hole drilling is discussed in a booklet that is published by Adolph Muehlmatt, Fifth and Elm Sts., S. E., Cincinnati, Ohio. The booklet also describes the outstanding features in the construction of the A. M. Sensitive Drilling Machine.

"The 'Hole' Story in One Word" is the title of a publication that has been issued by The National Automatic Tool Co., Richmond, Ind. The book gives details as to construction and uses of "Natco" multiple drilling and tapping machines.

For Sure Balance—

an absolutely level and solid "Way" is necessary



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are brought to an absolute *level* in ten seconds. No revolving parts.

The edges or "knives" upon which the work is tested are ground *true*, and are mounted upon the planed "ways" of a heavy bed or frame.

Standards adjustable to suit length of arbor.

Three sizes for floor—one for bench use

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The N. P. Bowsher Co., South Bend, Ind.

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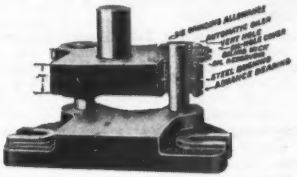
Automatically Oiled

DIE SETS



Standardized die sets, embodying many exclusive features, and a listing of 70,000 stock sizes afford a service that is unsurpassed.

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E. A. Baumbach Mfg. Co.
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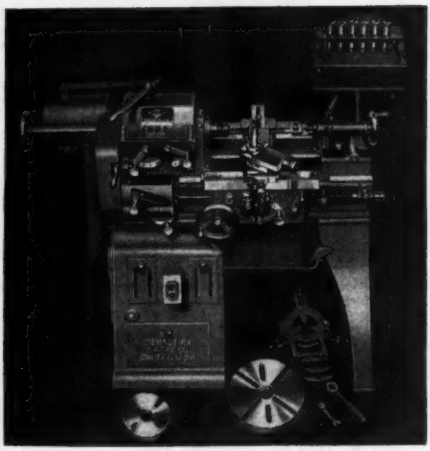
THE SMALL LATHE you have been looking for!

SIZES 11" TO 20" SWING



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POWERED far beyond its apparent size, generously proportioned and equipped with a completeness unequalled in its field, the

11" Gold Seal Heavy Duty Precision Tool Room Lathe

offers the manufacturer a long needed addition to his lathe equipment.

The time saving convenience, precision and versatility of this machine will reduce the cost of producing a wide range of parts — much work can be handled with it that formerly had to be done upon a larger machine.

All details sent upon request

THE SEBASTIAN LATHE COMPANY
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New York Address: Room 372, 50 Church St.

Milling Internal Keyways: A simple method of milling keyways in gears, wheel hubs, and other similar parts with the aid of a drill press and a special tool is explained in a booklet that is published by the National Machine Tool Co., 2271 Spring Grove Ave., Cincinnati, Ohio.

Save Time with Expanding Mandrels: How expanding mandrels will solve the problem of turning pieces with odd-size holes, and will increase production on duplicate work, is told in a folder that will be sent free upon request by W. H. Nicholson & Son, 136 Oregon St., Wilkes-Barre, Pa.

Ball and Roller Bearing Data Sheets: A complete set of data sheets showing all the dimensions and loads at given speeds, and giving instructions for mounting precision ball bearing and Hoffmann roller bearings, can be obtained without charge by addressing the Norma-Hoffmann Bearings Corporation, Stamford, Conn.

Grinding Wheel Information: A booklet which tells how grinding wheels are made and graded, and which give instructions for mounting wheels, operating speeds for different kinds of work, instructions for truing and dressing, and other information has been issued by the Norton Company, Worcester, Mass. Sent free upon request.

Correct Cutter Grinding: How cutter costs can be reduced and more production per grind of cutter obtained is told in Booklet "E," published by The Oesterlein Machine Co., 3319 Colerain Ave., Cincinnati, Ohio. Sent free upon request.

"Ohio" Shapers and Planers: The latest types of shapers and planers manufactured by The Ohio Machine Tool Co., Kenton, Ohio, are described and illustrated in a series o bulletins that have been issued by this firm. All the latest features of these machines, such as automatic lubrication, instantaneous feed, centralized control, and gear box, are described in detail. Free upon request.

Self-Tapping Sheet Metal Screws: Screws which are threaded and hardened in such a manner as to enable them to cut their own threads as they are screwed into sheet metal assemblies are described in a folder which is published by the Parker-Kalon Corporation, 192-196 Varick St,. New York City., N. Y. Sent free upon request.

Tapping Devices, Quick-Change Chucks, Stud-Setting Tools and Bench Tappers: A catalog describing the various types and kinds of tapping, drilling, and stud-setting devices manufactured by the Procunier Safety Chuck Company, 12 South Clinton Street, Chicago, Ill., can be obtained without charge by addressing this company. The catalog also tells the part that Procunier tools play in obtaining greater accuracy and less tap breakage.

Engine, Turret, and Gap Lathes are described in a series of bulletins that have been issued by The Rahn-Larmon Co., 2935 Spring Grove Ave., Cincinnati, Ohio.

Automatic Lubrication: Individually motor-driven pumps that keep the work flooded with lubricant are described in a booklet that has been published by the Ruthman Machinery Co., Front and Pike Sts., Cincinnati, Ohio.

Safety Grinding Wheels: The complete line of grinding wheels made by the Safety Grinding Wheel & Machine Co., Springfield, Ohio, is described in Catalog No. 11, which is issued by this firm. The book also contains instructions for operating grinding wheels, tables of grinding wheel speeds, pulley calculations, and other information for the user of grinding wheels.

Saving Time With Small Tools: A line of time-saving small tools, including "Use-'Em-Up" drill sleeve, "Wear-ever" chucks, collets, cutters, reamers and tap holders, counterbores, spotfacers, and other tools is described in Catalog 36, issued by Scully-Jones & Co., 1909 S. Rockwell St., Chicago, Ill.

Equipment For the Shop: Vises for the bench, drill press, milling machine or shaper; angle plates; adjustable clamps, jacks and other tools for the machine shop, are described and illustrated in a booklet that is published by the Sheldon Machine Co., 3253-55 Cottage Grove Ave., Chicago, Il. Copy free upon request.

"Monotrol" Geared Head Lathes: A new type of lathe, especially designed for precision work at high speeds, is described in a folder that has been issued by The Sidney Machine Tool Co., Dept. MS, Sidney, Ohio. Copy free on request.

"Chucks and Their Uses" is the name of a book which contains a full description of the different kinds of chucks and suggestions for the proper care of chucks, and tells how chucks should be fitted to lathes. It also contains a number of suggestions for general shop practice. Sent free upon application by The Skinner Chuck Co., New Britain, Conn.

Shaping with Modern Equipment: The Smith & Mills Company, 2889-91 Spring Grove Avenue, Cincinnati, Ohio, has issued a booklet which describes and illustrates the line of modern shaping equipment made by this firm. Copy free upon request.

Electric Drilling and Grinding Equipment: A book that is issued by The Standard Electric Tool Co., 1938 West Eighth St., Cincinnati, Ohio, tells how time can be saved, better work done, and the efficiency of the shop improved by the use of electrically-driven drilling and grinding equipment. Free upon request.

Engineering and Manufacturing Service: A complete engineering and manufacturing service for manufacturers who are not equipped to handle all of their own designing, experimental, or production work is described, with illustrations of the equipment available, in a bulletin that is issued by The Steel Products Engineering Co., Springfield, Ohio.

Cutting and Grinding Facts: A discussion of cutting oils and lubricants, together with descriptions and illustrations of various kinds of jobs upon which cutting oils are used, is contained in a booklet that is issued by the Sun Oil Company, Finance Building, Pittsburgh, Pa. Free upon request.

Rigidmilling Principles and Practice: A book that shows how the Rigidmil can be adapted to various kinds of usual and unusual milling operations, and which describes in detail the work that can be handled by this machine has been issued by the Sundstrand Machine Tool Co., Rockford, Ill. Copy free upon request.

Save Cutting Oil: How cutting oil can be separated from chips and thus reclaimed by the use of a centrifugal chip "wringer," is told in a bulletin that is issued free by the Tolhurst Machine Works, Troy, N. Y.

Chuck With Air: How time and labor can be saved by the use of air-operated chucks, cylinders, and other equipment is told in a book which describes "Hopkins" Air-Operated Equipment. Published by The Tomkins-Johnson Company, 620 N. Mechanic St., Jackson, Mich. Sent free upon request.

A Simplified and Improved Drive Control for Machinery: Two distinct types of plate clutches that have proved successful highly in the driving mechanism of machine tools are described and illustrated in a bulletin that will be sent free by the Twin Disc Clutch Company, Racine, Wis.

Multiple Drilling With a Single-Spindle Drill: Methods by which multiple drilling may be done on a single-spindle drill, using multiple spindle drill heads, are discussed in a bulletin that is issued by The United States Drill Head Co., 1954 Riverside Drive, Cincinnati.

Electrically-Driven Portable Tools: The "U. S." line of electric drills, die grinders, electric screw drivers, surface grinders, tool post grinders, and bench and floor grinders is described in Catalog No. 24, which has been published by The United States Electrical Tool Co., 2471 W. Sixth St., Cincinnati, Ohio.

Whiton Lathe Chucks: All kinds and sizes of standard and special chucks for the engine lathe, turret lathe, screw machine, or boring mill are described and illustrated in a book that is published by The D. E. Whiton Machine Co., New London, Conn. Copy free upon request.

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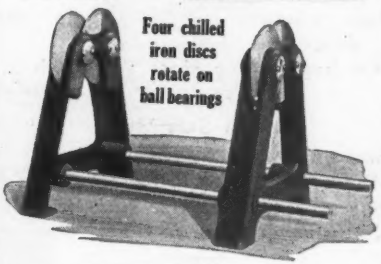

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Raver-in-Chief

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Maybe It's Both

Of questions that puzzle the boatists,
There's none that troubles 'em more
Than whether they're huggin' the shore too close,
Or huggin' too close to the shore.

You Said Ut

She's on committees and juries,
But gamble your last dime
That no diff what else she's on
She's never been on time.

A political candidate spouts 'bout the "Intelligence" o' the public till he's defeated.—From then on it's the "Ignorance' thereof.

Gettin' the other fellow's customers means nothin' unless you're holdin' Your own.

Same Ol' Line

I'll say to you,
I've kissed a few,
But none like you, dear Mary;
I feel somehow,
That up to now,
All's been preliminary.

The Wave o' the cop to hold you back while traffic moves in the other direction always seems like a permanent wave.

Thought without action is mos' as bad as action without thought.

Oh

"How'd I find myself
After the party?" asked Guzz;
"I jes' looked under the table,
An' there I was."

Blessed Are The Broke

The doctors test our pocketbooks,
Regardless of our ills,
The rich get operations,
An' the poor get off with pills—

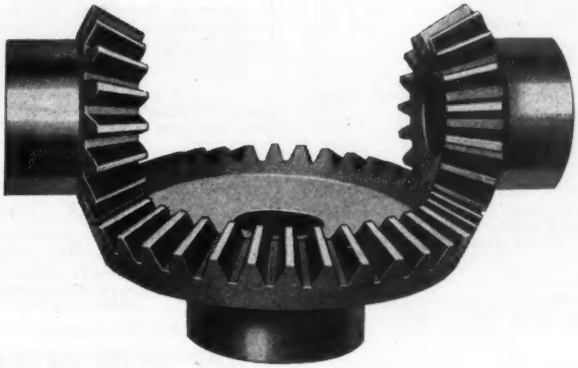
If you're a real financier, you'll cash in on your handicaps.

Once upon a time there was a man who was an atheist an' didn't believe there was a Heaven or Hell—Then he got married and found both.

You Know Him

He brags that he's self-made,
He makes you feel 'twas tuff
That on the job was wasted
An awful lotta stuff.

Our bevel gears are generated theoretically correct.



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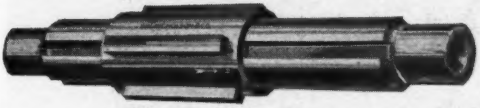

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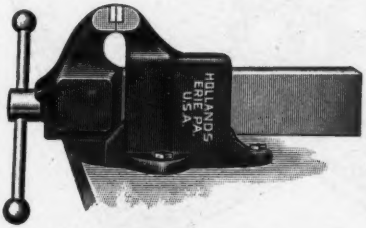

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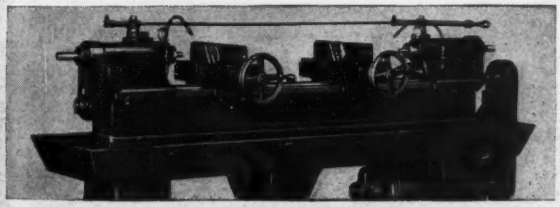

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